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AN INVESTIGATION OF CLOSED-CIRCUIT TELEVISION FOR TEACHING UNIVERSITY COURSES. INSTRUCTIONAL TELEVISION RESEARCH, REPORT NUMBER TWO.

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DESCRIPTORS- *INSTRUCTIONAL TELEVISION, *CLOSED CIRCUIT TELEVISION, *COLLEGE INSTRUCTION, *ACADEMIC ACHIEVEMENT, *ATTITUDES, FEASIBILITY STUDIES

WHILE FOCUSING ON THE POTENTIALITIES AND LIMITATIONS OF CLOSED-CIRCUIT TV TO IMPROVE BOTH TEACHING AND LEARNING, GOAL OF THIS STUDY IS TO PROVIDE FACTUAL EVIDENCE TO AID EDUCATIONAL INSTITUTIONS IN DECISION-MAKING. 12 SPECIFIC PROJECT OBJECTIVES, INCLUDING STUDY OF CLASS SIZE, TYPE OF COURSE, LOW COST TV SYSTEMS, FACULTY ACCEPTANCE OF TV, AND INSTRUCTIONAL METHODS ARE LISTED. EXPERIMENTS COMPREHENSIVELY COVERING POSSIBLE VARIABLES WERE CONDUCTED IN OVER 70 COURSES WHOSE TEACHERS VOLUNTEERED THEM FOR STUDY. 4 PROBLEM AREAS WERE INVESTIGATED AND STUDENTS WERE RANDOMLY ASSIGNED TO ALL TREATMENT GROUPS. FIRST, STUDIES OF THE COMPARATIVE EFFECTIVENESS OF CONVENTIONAL AND TELEVISED INSTRUCTION, EVEN THOUGH CAREFULLY DESIGNED TO CONTROL VARIABLES SUCH AS INSTRUCTOR, ENVIRONMENT, TECHNIQUE AND COURSE TOPIC, YIELDED NON-SIGNIFICANT DIFFERENCES IN STUDENTS' ACHIEVEMENT SCORES. USING THE SAME STATISTICAL PROCEDURES (ANALYSIS OF VARIANCE AND COVARIANCE), EXPERIMENTS INVESTIGATING DISTANCE FROM TV, CLASS SIZE, CLASS COMPOSITION, AND CLASSROOM SUPERVISION ALSO YIELDED NON-SIGNIFICANT DIFFERENCES. PROBLEM AREA 2, APPROPRIATENESS OF TV FOR UNIVERSITY TEACHING, EMPHASIZED THE WIDE RANGE OF USES OF CLOSED-CIRCUIT TV. STUDIES OF ACCEPTANCE, AREA 3, PROBED FACULTY, STUDENT, AND OBSERVER ATTITUDES THROUGH BEHAVIOR QUESTIONNAIRES AND BEHAVIORAL CHOICE TECHNIQUES. FINALLY, A SECTION ON FEASIBILITY CONCLUDES THAT IT IS PRACTICAL TO OPERATE CLOSED-CIRCUIT SYSTEMS WITH REGULAR UNIVERSITY PERSONNEL. (LH)

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EM 000507

Instructional Television Research

REPORT NUMBER TWO: The Academic Years 1955-1956 and 1956-1957

AN INVESTIGATION OF CLOSED-CIRCUIT TELEVISION FOR TEACHING UNIVERSITY COURSES

Research Conducted by the Division of Academic Research and Services

THE PENNSYLVANIA STATE UNIVERSITY

Project Sponsored by

The Fund for the Advancement of Education

Instructional Television Research

Report Number Two

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University Park, Pennsylvania

Spring - 1958

DEDICATION

John K. Weiss

March 25, 1920 — April 6, 1958

Humanist and realist

Friend of true educators

Devoted proponent of imaginative educational advancements

Man of wisdom on emerging educational developments, values and goals

A sagacious person, committed to the world of the intellect

A man who so served that others may better achieve

Acknowledgments

The introduction into the context of a large university of closed-circuit television with emphasis on research requires the cooperation of many persons. We gratefully acknowledge the interest, contributions and encouragement of Clarence Faust, Alvin C. Eurich, John K. Weiss, and Lester W. Nelson of the Fund for the Advancement of Education. Members of the Central Administration of The Pennsylvania State University have strongly and consistently supported the research. Those who importantly encouraged the project were President Milton S. Eisenhower (1955-1956), President Eric A. Walker (1956-1957), Vice President Lawrence E. Dennis, Comptroller S. K. Hostetter, W. H. Weigand of Physical Plant, A. C. St. Clair of Purchases, Louis H. Bell of Public Information, and R. V. Watkins, Scheduling Officer. The deans and department heads of several Colleges gave their approval to the research, and many of them evinced strong and continuing interest in the developments. Unusual and heavy demands were made on the cooperating departments and especially on the instructors who worked cooperatively on the project. The courses taught over television with their instructors are shown in Table 1, p. 4 and 5.

The student engineers who helped install, adapt, operate, and maintain the equipment performed a splendid service. Especially worthy of mention are: R. L. Horst, L. E. Matter, L. V. McClaine, W. F. Pohts, J. T. Raleigh, and E. Richardson.

Student teaching assistants, both undergraduate and graduate, contributed importantly to the practical management of television courses. The objective attitudes of students who served as subjects in TV classes and showed appreciation for the need to experiment with and improve college instruction, created an important and favorable condition for the project. In addition, the students who served as camera operators played an important role in making the television operation feasible. The critics of the experiment, both on and off campus, made their unique contributions by requiring those persons responsible for the research to sharpen their definitions of issues and problems, to design experiments to yield relevant evidence, and to conceptualize broadly and realistically the practical and theoretical implications of using closed-circuit television in university instruction.

The manufacturers of television equipment accepted the challenge by adapting existing television systems and developing new systems to serve the functions of instruction. They invested much time and energy in work with the project for which they did not receive immediate compensation.

Finally, it should be recognized that the faculty of the University evidenced unusual understanding and tolerance for explorations with new methods and modified approaches to instruction, and for the experimental approach in seeking solutions to critical present and future problems of academic instruction.

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I—Introduction and Perspective

Introductory Statement

This report covers the second and third academic years—1955-1956 and 1956-1957 of the Penn State Television Project. It is the second of a planned series of three reports, each of which will give full and systematic information on a wide range of problems which are under investigation. The intention is to provide educational institutions with substantial bases of factual evidence for making decisions on whether or not to use closed-circuit television in their instructional programs, and if so, to provide blueprints of tested approaches and procedures. At the same time, it is hoped that attention will be focused on the major problems, both practical and theoretical, which occur in the teaching and learning area of higher education. The central theme, therefore, is *not* television in higher education; the central theme is the improvement of both teaching and learning, especially the learning and academic achievements of students. Teaching by whatever methods, and the use of television, however employed, are only means and not goals. The general problem is to determine, on the basis of the best evidence available and obtainable, what are both the *potentialities* and *limitations* of closed-circuit television for accomplishing defined technical training and for achieving academic educational goals. It is the purpose of the Penn State reports to give the accumulated evidence from this research, and to do this with the greatest possible objectivity and with a balanced perspective.

For those interested in a summary of Report Number One, see Appendix pp. 109-110.

Scope and Financing of the Second and Third Years of the Penn State TV Project

The first year's work was evaluated critically during the summer of 1956 both by those responsible at Penn State and by the Fund for the Advancement of Education. Informed persons at Penn State favored continuation of the Project as a means of stimulating interest in the improvement of instruction and as a means of encouraging research on problems of teaching. It was considered desirable also to continue explorations of television as *one way* of dealing with anticipated faculty shortages in relation to expected increases in student enrollments. Administrators of the Fund for the Advancement of Education favored continuation of the Project because of the promising results of the first brief year of limited experimentation and because the Project represented an approach to one of the Fund's major efforts; namely to explore and to demonstrate ways of meeting problems resulting from increased student enrollments and shortages of teaching resources in the United States. It was believed that closed-circuit television might be one way of extending and making better use of superior instruction. Therefore, the University and the Fund agreed in principal to continue the Project through 1956-1957.

Financing the continued research became a problem. The Fund for the Advancement of Education proposed that the University should, after the first year, assume an increasing proportion of the *direct* expenses of the research in addition to basic and indirect costs. The University concurred but its 1955-1956 budget was at that time being presented to the Legislature of Pennsylvania, and hence commitments could only be made within the limits of the previous biennial budget. However, salaries for a full-time and a half-time staff member were shifted from the Project to a regular university budget (Psychology). Subsequently, the Fund agreed to finance the Project for the year 1955-1956. The Fund and the University agreed to a sharing of direct costs for the year 1956-1957, with the University increasing its contribution each year until 1959, at which time the Fund would terminate support for regular operations which would be covered entirely by the University. It was boldly assumed, subject to verification, that the expense to the University of regular operations of the instructional television systems would be repaid by net savings. Financing research was considered an additional expense for which Fund money could be spent justifiably. Therefore, funds supplied by the University were used mainly for the purchase of equipment and for regular operating expenses.

It became clear that in order to provide for the necessary research and for realistic operational tests of instructional television that at least five years of work would be required. Accordingly, tentative and general plans were drawn covering this period. Furthermore, it was realized that the scope of the Project should be extended to explore as many different courses as possible. Moreover, in line with the requirement that multiple systems of television equipment (which differ in complexity and cost) be demonstrated and tested, it was necessary to use not only one or more vidicon "professional" systems but also to introduce for regular use several less complicated and less expensive television systems.

Preliminary work during 1954-1955 showed the need for the reciprocal adaptation of college courses for television and television for college courses. During the first year's experimentation, conventional unadapted courses, with minor exceptions, were televised using the same instructors, the same methods and the same course content for both experimental television and control classes of students. Many problems and possibilities were defined for adapting courses for presentation over television and conversely of adapting television equipment and techniques to the requirements of good instructional methods and subject matter. Questions were raised repeatedly about the possibilities of producing and using kinescopic recordings for improving and extending instruction. It was hoped that investigation of these questions could be undertaken. Therefore, it was decided that all of these areas would be investigated as the Project was continued.

Agreements on Objectives between the University and the Fund for the Advancement of Education for 1955-1956

During June and July 1955, the University and the Fund developed and agreed to specific objectives for the Project's second year, 1955-1956.

The following paragraph is quoted from a letter proposal of June 4, 1955 from the University addressed to Alvin C. Eurich of the Fund:

"We have answered to a limited extent your basic question: 'Can you teach regular college and university courses by closed-circuit television for a full semester?' The answer is yes, for the three courses we have televised . . . However, we hasten to add that this should not be done routinely. Television projection of good (conventional) instruction, in brief, should require that the potentialities of television be fully used, and that the limitations be overcome. This basic operational principle, of which we are strongly convinced, requires the adaptation of courses and instruction to the characteristics of closed-circuit television and the adaptation of television to the demands of courses, instructors and students in the interest of improved effectiveness of teaching . . ."

A reply was received from Mr. Eurich on July 6, 1955. An abstract of the stated objectives as given in his letter follows:

1. To extend the Project to include eight or ten different courses with an enrollment of about 3,000 students in order to answer many additional questions related to considerations of appropriateness and feasibility of television to various kinds of courses.

2. To study variables of class size and patterns of instruction adapted to television.

3. To develop specifications of basic requirements for adapting large college courses to closed-circuit television and of adapting television to the requirements of courses and instructors.

4. To continue to explore the potentialities of closed-circuit television as a means of training college teachers.

5. To continue and expand the application and testing of low-cost television systems, especially in liberal arts courses, science laboratories, and clinical psychology training.[1]

6. To continue to work on the problem of faculty acceptance of television as a means of classroom and laboratory instruction.

7. To develop further than has been possible this year, means of solving problems of engineering and maintenance services within the limits of resources available at the University.

8. To continue to provide information and consulting services to the increasing number of educational institutions interested in installing and using closed-circuit television for instructional purposes.

It was also agreed that an effort would be made to obtain other support for work on the following two additional objectives:

1. To experiment with practical methods for making adequate use of video channels, and to determine the contributions thus made to the improvement of education.[2]

2. To develop and test practical and economic equipment assemblies and methods for recording appropriate parts of courses on sound film as an approach to reducing the costs of instruction and to demonstrate possibilities for extending the influence of good instruction to other school systems and institutions.[3]

Mr. Eurich's letter included additional general suggestions and recommended that an external advisory group of eight or ten persons should be selected and invited to observe and critically evaluate the Penn State TV Project (See Chapter 4, pp. 89-94.

These agreements established the general objectives and accordingly determined the direction and scope of work for the academic year 1955-1956. The generalized blueprint was drawn. The task then became that of putting it into effect. In doing this considerable freedom was permitted for adaptations and exploration and for taking advantage of opportunities as they developed.

Agreements on Objectives between the University and the Fund for 1956-1957

The general objectives for research and development work during 1956-1957 were formulated and agreed to by letter on May 11, 1956. The problems to be studied were stated by Mr. Eurich as follows:

1. Comparative effectiveness of varied methods of instruction employing closed-circuit television.
2. Relative appropriateness of television for use in different subject-matter areas of the University's program of instruction.
3. Practicality or feasibility in terms of management, equipment, operations, physical plant factors and cost.
4. The acceptability by students, faculty members and others of television as an instrument for use in residential instruction.

Furthermore, it was agreed to give special attention to the improvement of instruction, instructional efficiency and costs. It was proposed that the scope or capacity of the use of one system would be increased by providing for teaching simultaneously up to 800 students and by scheduling a full week of televised courses. Finally, it was planned to explore the

1 During the spring of 1956 a contract was developed and signed with the Naval Training Devices Center for installing and testing a low-cost, Dage 101 camera system in the Bainbridge Recruit Training School. Work is now being completed on this project.

2 A preliminary proposal was prepared and offered to the Office of Naval Research, Washington, on the problem of the potential contributions of visual communication for reinforcing conceptual learning. The proposal was not accepted.

3 A proposal was prepared and a contract negotiated with the Department of Defense for producing on kinescope recordings 16 one-half hours of the core materials in General Psychology and 18 one-half hours of the core and appropriate lecture-demonstrations of General Chemistry.

possibilities of full-scale adaptation of one or more courses to televised instruction in order that the medium might be used to the greatest advantage.

This report will show that most of the objectives outlined initially were accomplished and that some were exceeded. Other problems continue to be investigated. Study of a few sub-problems was of necessity deferred beyond 1956-1957. Additional work, not planned during the summer of 1955 and the spring of 1956 was undertaken and accomplished.

General Characteristics of the Project

The Penn State TV Project has a number of general characteristics which should be known in order to understand how it operates. The characteristics of the Project and of its specific University may account for both successes and failures. Furthermore, it may be desirable to consider the Project as a kind of model which may be modified and adapted by other educational institutions.

Administratively, the Project was placed in the College of Education but organizationally it functioned as an all-university research and services activity. The Director and Associate Director were responsible, somewhat informally, to the Dean of the College of Education, the Vice President for Academic Affairs, and the President of the University.[1] The budget was administered through the Department of Psychology, the College of Education and the Comptroller. However, the President's Office made final decisions on major fiscal questions and plans. Close working relations were maintained between those directly responsible for the Project, the Scheduling Officer of the University and cooperating department heads or chairmen. In addition, close relations were established and maintained with those instructors who were teaching courses over television.

Generally, decisions as to whether courses were to be scheduled for television were made, following invitations or suggestions, by the instructors themselves in joint and often informal discussions with the Project directors, the scheduling officer and responsible department chairmen.

The entire staff of the Project was oriented to serving and assisting the instructors. This service included the operation of equipment and any additional help needed in courses within the limits of staff time and resources, for the production and presentation of instructional materials. In practice, however, the instructors and their assistants did most of this latter work.

Research proposals and designs were usually developed by the Project Staff, presented to instructors for approval and carried out with their close cooperation. However, instructors were strongly encouraged to state research problems of interest to them, to propose approaches for their investigation and to cooperate in the execution of their proposals.

In some courses where intensive controlled research was being done, it was necessary for research members of the Project Staff to carry the main responsibility for the conduct of the experiments. In such courses, the Staff took a very prominent part in conducting or managing the course and in the construction and administration of tests and measurements. Nevertheless, the instructors still had full control of their instruction.

Continuous efforts were made to inform the administration, faculty, students and the general public of what had been accomplished, what was being done and of general plans for the future. Personal reports were made to faculty groups, written reports were widely distributed, news releases were prepared for University publications and the public press. Close working relations were maintained with the Office of Public Information and reporters for student publications.

Many different groups were encouraged to observe the actual operations of the instructional television systems and the TV classes. These included administrative officers, members of the Board of Trustees, the faculty and representatives from other educational institutions in this and other countries.

Thus, it can be seen that the Penn State TV Project was operating in a realistic university context. It operated in the full public view and was subjected to both positive and negative public opinion pressures.

As can be seen later in this report, a wide range of problems was attacked on the basic-applied continuum. However, of necessity the emphasis was on the solving of practical problems. At the same time, the Project was a "social action" program. The realism of its setting and its objectives required that the activity and its results be accepted and applied by the people involved and by the University community. Therefore, research and application proceeded simultaneously and in cycles.

The guiding proposition of the Project was that closed-circuit instructional television should succeed or fail on its own merits. The central concerns of the Project Staff were to provide a testing or proving ground where both the merits and limitations of instructional television could be fairly determined, and to collect and make available dependable evidence so that sound decisions could be made by responsible and informed persons on the basis of the evidence. Instructional television was not intentionally propagandized either within the University or elsewhere. The Staff of the Project strongly opposed over-generalizations, either favorable or unfavorable.

Kinds of Explorations and Research

Many kinds of work were done within the Project, and this range of work increased as research continued.

A major effort was that of televising courses regularly as required by the instructional program of the University. The amount of this work is shown in Table I.

Regardless of what type of study was being conducted, whether it was carefully planned research, demonstrations, explorations, or preparation, courses had to be regularly and satisfactorily televised. It is estimated that about half of the Staff's time was invested in the regular televising of courses, while the other half was used in planning and conducting research.

Courses which were televised can be classified into several categories. Some courses were scheduled regularly after

1 An organizational change was formalized on August 1, 1957, when the Instructional Research Program became the core of the Division of Academic Research and Services, under the Vice President for Academic Affairs.

having been used for comparative research. Others were televised in order to meet increasing enrollment pressures. Courses were televised in order to demonstrate whether or not they could be acceptably presented. Similarly, limited parts of other courses were televised for demonstrative purposes on a trial basis in order to obtain qualitative information and judgments about the appropriateness of television for those courses. Other trial courses were included as part of the planning preparatory for controlled research. Finally, some courses were televised as part of controlled experimentation from which comparative quantitative data were collected.

TABLE 1

Summary of Courses Taught by Television—Spring 1955 to Spring 1957 Inclusive

Courses, Semester and Year	*Hours per Week of TV*	*TV Instructors*
Spring 1955		
Chem. 2 (Sect. 1)	2	G. W. Smith
Chem. 2 (Sect. 2)	2	C. G. Haas T. Wartik
Psych. 2 (Sect. 1)	3	J. F. Hall
Psych. 2 (Sect. 2)	3	K. R. Smith
Psych. 17	3	C. R. Adams
Total	13	
Fall 1955		
Chem. 1 (Sect. 1)	2	G. W. Smith
Chem. 1 (Sect. 2)	2	C. G. Haas T. Wartik
Psych. 2 (Sect. 1)	3	J. H. Grosslight
Psych. 2 (Sect. 2)	3	J. F. Hall K. R. Smith A. J. Slivinske
Psych. 17	3	C. R. Adams
Air Science 3	2	W. Aiken H. O'Neal
Commerce 30	3	S. C. Tanner
Education 1	3	D. W. Russell G. R. Selders H. C. Kranzer J. Alesandro
Economics 2	3	A. H. Reede
Music 5	3	E. C. Wareham
Speech 200	3	E. R. Gilkey D. Barton H. Hill J. Conway H. J. O'Brien H. G. DeBoer R. T. Oliver D. Drum
Total	30	

TABLE 1—*Continued*

Courses, Semester and Year	*Hours per Week of TV*	*TV Instructors*
Spring 1956		
Chem. 2 (Sect. 1)	2	G. W. Smith
Chem. 2 (Sect. 2)	2	C. G. Haas T. Wartik
Psych. 2 (Sect. 1)	3	J. H. Grosslight
Psych. 2 (Sect. 2)	3	F. L. Whaley R. Barthol C. R. Carpenter A. J. Slivinske
Air Science 2	2	W. Aiken H. O'Neal
Accounting 1	3	S. Woolsey
Commerce 30	3	S. C. Tanner
Economics 2	2	A. H. Reede
Education 1	2	A. W. VanderMeer H. M. Davison
Economics 2	2	A. H. Reede
Elect. Eng. 8	2	C. R. Marsh
Music 5	3	E. C. Wareham
Political Science 3	2	R. W. Brewster
Sociology 1	3	W. Coutu
Speech 200	2	R. T. Oliver
Total	36	
Fall 1956		
Chem. 1 (7 sections)	2	G. W. Smith C. G. Haas T. Wartik
Psych. 2 (Sect. 1)	3	J. H. Grosslight F. L. Whaley
Psych. 17	3	C. R. Adams
Air Science 3 (Sect. 1)	3	W. Aiken
Air Science 3 (Sect. 2)	3	G. D. Brigham
Accounting 1	3	S. Woolsey
Commerce 30	3	S. C. Tanner
Economics 2	2	A. H. Reede
Education 1	2	A. W. VanderMeer
Elect. Eng. 8 (Sect. 1)	2	C. R. Marsh
Elect. Eng. 8 (Sect. 2)	2	
German 1	1	P. A. Shelley
Music 5	3	E. C. Wareham
Political Science 3	2	R. W. Brewster
Sociology 1	3	W. G. Mather
Total	37	

TABLE 1—*Continued*

Courses, Semester and Year	*Hours per Week of TV*	*TV Instructors*
Spring 1957		
Chem. 2 (Sect. 1)	2	G. W. Smith
Chem. 2 (Sect. 2)	2	C. G. Haas T. Wartik
Chem. 5	2	J. A. Dixon
Psych. 2 (Sect. 1)	3	J. H. Grosslight
Psych. 2 (Sect. 2)	3	F. L. Whaley
Psych. 17	2	C. R. Adams
Air Science 4	2	W. Aiken G. D. Brigham
Accounting 1	3	G. K. Nelson
Economics 2	2	A. H. Reede
Education 1 (Sect. 1)	2	A. W. VanderMeer
Education 1 (Sect. 2)	2	J. P. Driscoll E. Fuller
Engineering 1	1	W. D. O'Connell
Elect. Eng. 9	2	G. E. Simaitis
French 30 / French 302	Combined 2	S. Belasco
German 1	1	P. A. Shelley
Ind. Eng. 131	1	W. Armstrong
Meteorology 300	2	H. Neuberger
Music 5	3	E. C. Wareham
Sociology 1	3	W. G. Mather
Education 424	1	G. M. Torkelson
Professional Training Courses using TV		
Speech 437	2	H. E. Nelson
Drama 481	2	H. D. Sherk L. F. Kepler
Education 487 C	1	G. M. Torkelson
Journalism Dept.	(occasional use)	R. O. Byers
Total	46	
Uses for Laboratory Observation and Teaching Demonstrations		
Metallurgy Dept.	(occasional use)	R. W. Lindsay
Speech Dept.	(occasional use)	E. R. Gilkey

Controlled research on problems of instruction does not have an established place in most universities. Such experimentation is a relatively new introduction at Penn State. Therefore, research attitudes, understanding and acceptance of research apart from television had to be encouraged and developed. The requirements of research on instruction make demands on teachers which are in addition to their regular teaching loads. When the increased responsibilities and work of teaching large classes over television are added to research requirements, it can easily be understood that faculty cooperation will have definite limits. Gaining cooperation for teaching over television is one hurdle; gaining cooperation and acceptance for controlled experimentation on instruction is an additional and even higher hurdle. In these terms it is understandable why only a portion of the total number of courses televised at Penn State were available for controlled experimentation. Even with these courses it was necessary from semester to semester to re-assess the instructors' and students' tolerance level for research and decide whether to continue or to interrupt experimentation. For example, both with chemistry and psychology it was found necessary to interrupt experimentation for periods of recovery. It should be observed that the demands of research in a course may at times weigh against the acceptance of television both by the instructors and the students.

Finally, within the total work pattern of the Project many incidental, brief, exploratory uses of one or more of the TV systems were employed. Demonstrations were conducted, for example in home economics classes. Microscopic specimens of metals were shown by means of television to metallurgy classes and the same was done for students in archaeology. Drama and speech courses used a TV system for professional training. Large numbers of entering freshmen were shown, by means of television, how to interpret and use their own test scores from batteries of tests. Interviews and panels were televised to audiences and conferences. Occasionally, overflow audiences from important public lectures were accommodated in TV classrooms. All of these auxiliary, introductory and exploratory uses of television, when well done, favorably affected the acceptance of television in the University. This was made possible by providing opportunities for direct observations and information for many faculty members and students who otherwise would not have had direct personal experience with the operation of closed-circuit systems.

General Areas of Research and Development

The objectives and problems which were proposed by the University and accepted by the Fund for the Advancement of Education constituted a preliminary plan for 1955-1956 and 1956-1957. This general plan had to be developed and adapted to the possibilities, limitations and realities of the academic program in which the research was to be done. The methods and procedures, as well as the characteristics of the Project's organization, both restricted and advanced the studies. For example, the largely voluntary basis used for scheduling courses on television limited the range of different kinds of courses which could be sampled during the year. At the same time, this voluntary basis for selecting TV courses increased faculty cooperation for those who did volunteer their courses for the Project, and thus provided a relatively valid behavioral test of faculty acceptance.

FIGURE 1. TYPICAL RECEIVING ROOM SHOWING PLACEMENT OF 24" TV RECEIVERS. RECEIVERS WERE USUALLY PLACED ON WINDOW SIDE OF ROOM TO REDUCE REFLECTIONS, AND WERE OPERATED WITH WINDOW SHADES PARTLY DRAWN, WITH NORMAL ROOM LIGHTING

While original plans and agreements were being made, it became apparent that the full range of demonstrations, explorations, and research could be classified under four general problem areas: (1) comparative effectiveness, (2) appropriateness, (3) acceptability, and (4) feasibility. Therefore, the Penn State TV Project began to operate within this general framework of problem areas during 1955-1956 and continued to do so. Furthermore, this report has been organized in terms of these major problem areas.

Comparative Effectiveness

Problems in this area include studies of the relative effectiveness of conventional instruction and the same instruction presented over closed-circuit television. The experimental variable in such comparisons is the communication system used for the presentation of the instruction. Ideally, all other variables should be controlled. Studies of comparative effectiveness of conventional and televised instruction, with television as the only independent variable, require that the same teachers, using the same methods and covering the same subject content, teach at least two groups of students who have been randomly assigned to the comparison groups—one of which is taught directly, face-to-face or conventionally, and the other of which is taught over television.

Comparative effectiveness studies can also be conducted within the limits and patterns of a televised course where a number of TV classes in separate rooms are available at the same hours. Given a television section consisting of several hundred students assignable to a number of classrooms, the students can be randomly assigned to these classrooms. Then, methods and procedures which are relevant to teaching effectiveness can be varied for different groups of students in different TV classrooms. Thus, a set-up with closed-circuit television provides instrumentation and possibilities for investigating such problems as variations in TV class sizes, different patterns and degrees of class supervision, the effect on learning of the opportunity for students to ask questions of the in-

structors, or the effect of workbooks and other out-of-class activities on the achievement of students.

In all types of comparative effectiveness studies it is obviously necessary to use the best possible tests, examinations and other measures for all comparison groups. Ideally these instruments should adequately and reliably sample the subject matter of the courses; they should relate to defined operational course objectives and the scores made on them should be validated against external criteria. Generally, educational measurements have *not* been validated nor was it possible for the Penn State TV Project to meet this requirement during 1955-1956 and 1956-1957. However, strong emphasis was put on the use of reliable tests.

Finally, it should be observed that the availability of closed-circuit television systems provides instrumentation and favorable conditions for controlled research on a very wide range of problems, including the comparison of instructional methods designed to improve teaching. These problems with television, have become more readily subject to experimentation.

Appropriateness

It is axiomatic that instrumentation may be appropriate and suitable for some functions and purposes and not for others.

For example, in a course of study which requires the presentation of stimulus materials in color and where color is crucial to learning, understanding and appreciation, the use of black-and-white television for presenting the stimulus materials is likely to be limited and somewhat inappropriate. In this case tests are needed which would be appropriate for courses which require color in their presentation. Biological science courses which depend on the use of stained histological preparations and fine arts courses which present paintings need to be tested. Furthermore, it is conceivable that some kinds of teaching and learning are dependent on a degree of high optical resolution of detail which exceeds the resolving powers of standard television systems and receivers. Finally, on an *a priori* basis it may be judged that in courses where teaching and learning depend heavily on consecutive, thematic and intense discussions between teachers and students and among students themselves, closed-circuit television alone may not be entirely adequate or appropriate, and therefore supplementary procedures may be required.

At the other extreme, when instruction and learning involve the presentation and perception of kinds and patterns of stimulus materials that fall well within the limits of the capacities of television's video and audio channels, then it would seem that television, other things being equal, would be adequate and appropriate for presentation of the instruction. For example, the courses in general psychology, sociology, political science, and economics and history as conventionally taught at Penn State have mainly included lectures and graphic communication using blackboards; these can be televised. Some courses of this type require supplementary discussion sessions and these can be provided in addition to the TV sessions. Theoretically there would seem to be little question but that the capacities of the TV systems are adequate and appropriate for the conventional lecture-graphic parts of these courses. In courses like accounting and chemistry, blackboard presentation of figures, calculations and the derivation of formulae may test the limits of camera coverage and require adjustments in camera operations and in the lettering and use of space on the blackboard.

So far we have considered only full courses or the lecture and lecture-demonstration parts of courses. The possibility of using closed-circuit television is also being explored for presenting special kinds of instruction within courses which are otherwise principally taught without television. Examples would be demonstrations involving young children for a course in remedial reading or exhibiting specimens of artifacts and demonstrations for a course in archaeology.

Appropriateness would also include studies of various patterns of using television in conjunction with other kinds of teaching and learning activities such as recitation sections, individual coaching and independent study, conferences and library work.

Furthermore, those courses for which televised presentation is appropriate may require modification and adaptation for television. None of the courses televised and used in experiments in 1955-1956 and 1956-1957 had been planned and developed especially for presentation over television. Therefore, the problem was one of making adaptations of existing courses to television. It is a most difficult task to decide what adaptations are needed and then to make the indicated adaptations. Established courses are not easily modified. Furthermore, experienced teachers find that their courses become strongly integrated as personal habit systems and hence they are difficult to change. The best possible approach in some areas may be the planning and developing of new courses with the view to presenting them over television taking full advantage of the medium.

Should courses be adapted for TV presentation? This may be necessary but it is not the sole reason for course adaptations. The crux of the problem is to determine whether the effectiveness of a course in terms of the educational needs of students is improved by its adaptation to television. It is true that the video channels might be more fully used by providing more pictorial-graphic and other visual stimuli for communicating some kinds and amounts of information to students. However, adaptation of courses for television implies much more than applying many of the production techniques of professional television, radio and drama. It means more than merely presenting "visuals" and "live" demonstrations in order to use the available video channels. Adaptation of courses to television and of television to courses should be proposed, justified and defended in terms of *improvement of the courses as one part of the academic and personal development of students.*

In this connection it would seem that television has many possibilities for the effective presentation of a wide variety of learning experiences: close-ups of small objects, models, demonstrations, motion and still pictures, charts, guest speakers and panel discussions. Furthermore, the function of bringing remote information and situations into the classroom offers great possibilities.

FIGURE 2. CONTROL ROOM, SPARKS BUILDING, SHOWING CONTROL CONSOLE, VIDEO MONITORS, AND EQUIPMENT RACKS

The problem of appropriateness of television for different courses raises considerations other than subject matter; instructors and students are especially involved. The questions are not only *for what courses* but *for whom* is instructional television appropriate, suitable and adequate? It is generally realized that instructors should be selected (or be allowed to volunteer) for the demanding tasks of instructing over television. However, it is *not* generally realized that students, too, may need to be selected (or be permitted to select themselves) for receiving instruction over television. Personality traits of instructors and of students may be more important than subject matter in determining a healthy marriage between instructing-learning behavior and the medium of communication. It may be reasonable to speculate that in a television section of 300 to 800 students, some percentage of them should be selectively removed from the TV section and taught by other procedures. Sensory limitations, inadequate or interferring habits of observation and study, inability to take responsibility and to discipline themselves in TV classrooms, negative emotional sets and attitudes as well as variability in capacities to learn may be some of the factors which could be used as a basis for selectively assorting students into courses and into classes where different teaching and presentation procedures are used. This viewpoint extends to other courses than those taught over television. There may be students in conventionally taught courses who would show greater academic development in TV courses.

Determination of whether or not specific courses or parts of a course are appropriate for use in closed-circuit television depends on complex judgments made on many different criteria. Examples of the factors which should be used as a basis for judgment of the appropriateness of closed-circuit instructional television are: The nature of the subject matter,

the full potentialities of the video and audio channels of the TV system, the data on comparative effectiveness, the reactions and characteristics of both instructors and students and the size of the enrollment.

Acceptability

It is quite possible that televised instruction may be rejected, within the democratic climates of most educational institutions in America, even if proven to be very effective and highly appropriate for courses, instructors and students. There are many guardians controlling proposed changes in educational practices in institutions of higher education. These guardians have varying degrees of decision power relative to what shall and shall not be done in colleges and universities. The institutions' constituents have a voice. Boards of trustees may formulate, veto or approve governing policies and procedures. Administrative officers, especially those who determine budgets, have power and relevant responsibilities for discouraging or encouraging the employment of various educational procedures. Policies and procedures committees and senates or councils may make decisions for or against the employment of instructional television in educational programs. General student reactions in most institutions are important factors in determining the course of events. Finally, the negative reactions of militant individuals and small organized minority groups of faculty members may determine whether or not closed-circuit television can be used for instructional purposes.

The area of acceptability can be subdivided. At Penn State, since teaching over television is a choice made initially by the instructors themselves and thereafter by department heads, deans and scheduling officers, it can be assumed that the participating TV instructors have accepted at least temporarily the televising of instruction. They have been agreeable to committing themselves and their courses to the adventure. However, the balance of attitudes with any instructor or team may shift at any time from acceptance to rejection. Thus, there is the question of how long the acceptance will continue—for a short period or permanently. Acceptance for what purposes is also important. Acceptance temporarily as a novelty, as a demonstration or as a trial is one reaction; acceptance as an experiment is another; acceptance on a continuing and relatively permanent basis for teaching specific courses is still a different reaction. Furthermore, there are variations in the strength of acceptance depending on degrees of personal involvement. Teaching over television may be either accepted or rejected by an instructor for "me" and "my course." Likewise strong negative or positive attitudes are held and expressed regarding other faculty members who teach over television or regarding televised instruction in general as used in the University.

It is important to investigate the degrees of acceptance and rejection of instructional television not only to determine the amount of support or resistance to this new educational procedure, but also to determine the changes in attitudes which occur with time. It is important to know what the rational as well as the irrational determinants are which produce positive and negative attitudes. In terms of these considerations, the introduction of closed-circuit instructional television, however *effective, appropriate* and *justifiable,* may fail or succeed depending on the attitudes of the faculty in institutions where faculty opinion influences policy, decisions and action. Therefore relevant issues and arguments regarding acceptability should be defined and measured. Then, to the extent that these factors are related to reasoned considerations and relevant evidence, it should be possible to resolve the issues. On the other hand irrational reactions are difficult to modify and hence may have to be tolerated as a part of the price paid for introducing changes into conventional educational institutions.

Since the Penn State TV Project is a pioneering development involving radically different procedures for presenting instruction, it is important to evaluate the currents and trends of attitudes toward the *essentials* of this TV project and to assess the main factors and conditions which cause these attitudes. It is a reasonable assumption that other institutions which become interested in instructional television will need to deal with attitudinal problems as the necessary faculty cooperation is sought.

Feasibility

Instructional television can be very effective, highly appropriate, and accepted in an institution, and yet it may not be feasible or practical to use closed-circuit systems for teaching. Initial and operational costs are certainly factors which might prevent the establishment of a program of instructional television. Dependability of equipment and the amount and difficulty of engineering maintenance may be crucial. Staffing of systems and management of large classes may prove to be impractical for some institutions. The scope of operations, including the number of classes served, the size of classes and the space requirements are other considerations related to questions of feasibility, after basic decisions related to educational questions have been made. In brief, all factors which relate to feasibility or practicality should be analyzed and the results presented as part of the over-all justification of closed-circuit television employed for presenting good or superior instruction to large numbers of students. The Penn State TV Project continued to collect information on feasibility factors during 1955-1956 and 1956-1957.

Summary

Four general problem areas of research on the use of closed-circuit television have been defined. These include (1) effectiveness, (2) appropriateness, (3) acceptability, and (4) feasibility.

The main body of this report will deal with general and specific problems which are classified under these four main headings.

2—Studies of Comparative Effectiveness

Introductory Statement

Studies of comparative effectiveness have been conducted on a wide range of specific problems. The first study sought to determine the relative effectiveness of conventional methods of teaching compared with the same methods employing closed-circuit television as a means of presenting instructional stimulation to students. Furthermore, in order to ascertain the degree of generality of findings, it was necessary to include in the experiments an adequate sampling of courses, a number of different teachers and student populations, as well as varied instructional methods.

As research work continued and became increasingly intensive, controlled and systematic, the focus of attention shifted from comparisons of conventional and televised instruction. Questions were formulated about the comparative retention of learning. Does learning that is instigated via television persist as long and as well as learning stimulated by conventional methods? Questions were raised about class size, the physical arrangements of television classrooms and the distance of students from receivers. Many other problems emerged as efforts were made to improve the management of courses taught over television in the interest of improving the quality of instruction.

Do different ways of assorting students in television classes relate to differences in the academic achievements of students? What are the best methods and arrangements for supervising or proctoring classes? Indeed, is supervision of some kind necessary and desirable? Can academic achievement be increased by providing different kinds of class situations for students? For example, should students have both direct and televised instruction on a schedule of rotation? Is instructor-student discussion contributory to learning in all courses, and how can opportunities for discussion be provided for large, multiple-section television classes? How is the criticism to be answered that students who are taught over television cannot interrupt the instructor to ask questions or clarify points of information? How can supplementary study, such as the use of workbooks, be arranged and does it improve students' performance in the course? Can students be given responsibility for class attendance and for independent study, and if so, what will be the effects on their achievement? When courses presented over television are adapted to that medium by extensive use of visual-graphic and other realistic instructional materials, does this adaptation increase the learning of students as compared with lecture-blackboard presentations? A related basic question is whether or not there are differential effects, attributable to television, on the formation and modification of attitudes and value judgments of students. Finally, in recognition of the possibility that the attitudes of students toward the course, the teacher(s) and general methods of teaching, as well as toward television, may affect achievement, what is the relative importance of these attitudinal factors?

These questions relate to some of the fundamental issues of higher education. Learning of facts and principles is involved as well as the learning of attitudes, values and the acquisition of abilities to make complex judgments.

In order to understand and interpret the following research results, it is necessary to know that the experiments generally were done with well developed courses taught by the best teachers available at Penn State, and that where comparisons between methods of teaching were involved, the same instructor taught by both procedures. These conditions set strict limits to the differential effects which could be expected as a result of varying such factors as class size, class composition, discussion procedures, question-answer opportunities, and the use of visual materials. It should be realized, also, that the instructors who participated in the experiments were mature and experienced teachers who had years of practice in using methods appropriate to direct or face-to-face teaching. Hence, it might be expected that these highly developed teaching skills would be more advantageously employed in conventional instruction than in the relatively new medium of televised instruction. Similarly, this generation of college students has had extensive training in learning from conventional methods, and very limited training in learning from demonstrations, panel discussions of experts or even from visual-graphic stimuli including motion pictures when presented over television.

Experimental Designs

The designs most commonly used in the experiments to be described in this section of the report have involved quite simple treatment plans. Typically, one independent variable has been manipulated. The independent variable has consisted of two or three conditions which have been imposed on two or three groups of subjects. These simple treatment plans provided the desired comparisons and had the advantage of being easy to manage.

Randomization has actually been incorporated in every experiment reported. Consequently the probability statements which appear in each evaluation possess a factual quality and can be interpreted as being approximately accurate. Since differences among subjects constitute a source of large errors in psychological and educational experimentation, randomization has been applied in the critical operation of assigning subjects to the conditions of the experiment.

The random assignment of subjects has usually taken one of three forms. Whenever possible the entire group of students enrolled in the course in which the experiment was to be conducted has been divided randomly into the desired number of sub-groups. Where it was impossible to exercise

TABLE 2

RESULTS OF RETENTION STUDY IN GENERAL PSYCHOLOGY

Methods of Instruction	N	Final Examination			Retention Examination			Mean Loss
		Mean	σ Dist	σ Mean	Mean	σ Dist	σ Mean	
1. TV Instruction only	63	83.63	12.80	1.63	72.00	11.84	1.50	−11.63
2. Conventional direct instruction	24	86.17	10.08	2.10	75.00	10.74	2.24	−11.17
3. Direct instruction in Originating Room	27	84.26	11.47	2.25	68.96	11.92	2.34	−15.30
4. Direct instruction (Groups 2 & 3 combined)	51	85.16	10.77	1.52	71.80	11.67	1.65	−13.36

this degree of control over all students, the randomization procedure was applied to a core of students within the total group. The experiment was then conducted and evaluated only with reference to this experimental core of students which had been randomly assigned to the conditions. Finally, in those instances in which repeated experimentation was carried out on the same subjects, the groups were always reconstituted randomly after one experiment was completed and before the next was undertaken.

The randomization procedures varied in unimportant ways, depending on the particular situation. The sorting or selecting of subjects was always guided, however, by the sequence of numbers in a table of random numbers.

Since randomization only distributes errors and does not affect their magnitude, and since differences among subjects are large and enter experimental data as errors, attempts were made to reduce the magnitude of these errors and thereby increase the precision of the experiment. Whenever possible, pre-tests were employed prior to differential treatment and these measures were used to adjust the final measures on the dependent variable. The probability of correctly rejecting the null hypothesis was thereby increased. The particular method of analysis employed was the analysis of covariance. Where pre-tests could not be employed, or where they turned out to be uncorrelated with the post-tests, the method of analysis used was analysis of variance.

In every case a test of the homogeneity of sample variance was performed. When analysis of covariance was employed, a test of the homogeneity of regression coefficients was also performed routinely.

The .05 level of significance has been employed throughout the evaluations. The probability associated with each test of significance has not been reported. Instead the practice of indicating whether or not the obtained probability exceeded the criterion level has been adopted.

Measurement

A considerable amount of attention has been given to problems of measurement. Within the limits of the resources available to the Project, a very substantial amount of staff time has been invested in the selection of measures from those already available, as well as in the development and refinement of new tests and scales. Whenever it has been practical to do so, evidence of reliability has been obtained. The correlations among the various response variables used in a particular experiment have also been determined.

Fairly extensive application has been made of the techniques of item analysis, after which the better items have been selected for future use and attempts have been made to improve others by revision. Much of this work took place in conjunction with attempts to develop, for the course in General Psychology, tests which measured more significant learnings than memory for specific details.

COMPARISONS OF DIRECT AND TELEVISED INSTRUCTION

Retention of Learning in General Psychology

Studies of the comparative effectiveness of teaching conventionally and by television were conducted in several courses during 1954-1955. General Psychology was one such course and 301 students completed the full semester of work. Of this number 152 were taught exclusively over television. The remainder was divided into two comparison groups. There were 74 students in one group which was taught conventionally, and 75 in a second group, taught in the classroom from which the instruction originated. Comparisons were made of the achievements of the three groups by means of carefully prepared periodic tests and a final end-of-course examination.

Since no significant differences were found, the general conclusion drawn from this experiment was that the students who were taught for a full semester over television learned as much as those who were taught conventionally.

In the academic year 1955-1956, 236 students out of the original 301 who had taken part in the experiment the previous year, returned to the University. Of this number 147 were assembled to take the final examination over again, without prior warning, as a means of providing data on retention of information.[1] Students who had taken or were taking additional psychology courses were eliminated and this reduced the number available for re-examination to 114. Of

1 C. C. Waggoner, The Differential Effects of Closed-Circuit Television and Non Television upon Attitudes and Long Term Retention, M.S. Thesis, The Pennsylvania State University, January 1957.

this number 63 had been taught exclusively over television, 24 had been taught by conventional methods, and 27 had received instruction in the TV originating classroom.

There was an interval of 218 days between the post-course final examination and the re-examination. Table 2 shows the results of both examinations.

The general conclusion drawn by the experimenter on the basis of his study, conducted largely independently of the TV Project Staff, was the following:

"Hence, it can be concluded that those students who were taught by television not only recalled the course material equally as well at the close of the semester as did those students who were taught either by conventional teaching method or in the TV originating room but also the different groups retained approximately the same amount of course material after the two hundred eighteen day interval."

Interpretations of the conclusion of the retention study should take into consideration the possible selective attrition of subjects. The group re-examined was not a random selection from the original experimental and control groups. However, the similarity in the two variability measures on the groups suggests that the factors operating selectively on the re-examined population were not those of ability and achievement. Pending further investigation, the conclusion as to the equivalence of retention of learning as measured is tentatively accepted for students taught over television and conventionally.

Comparisons of Direct and Televised Instruction in General Chemistry

The lecture-demonstration part of the second semester of General Chemistry was used in studies of direct and televised instruction during the spring of 1955. Results obtained during the entire Spring Semester showed high correlation among different tests and between these and final examination scores. The instructors for the course agreed to continue experimentation during the Fall Semester of 1955-1956 with a different experimental approach and problems. One of these problems which will be reported here involved further comparisons of direct and televised instruction of chemistry lecture-demonstrations. Other problems studied in this course during the fall of 1955 are reported under the headings of Varied Class Size and Distance from Source of Instruction, Provision of Lecture Outlines, and Student Reactions to Televised Instruction. Two large sections of 588 students were used in the experiment. Section 1 of 276 students was taught on Tuesday and Thursday at 9: 00 a.m., and Section 2 of 312 was taught on Tuesday and Thursday at 11: 00 a.m. The same experimental design was applied to each section, thus providing replication of the experiments. Furthermore, students were randomized into the treatment groups after the large sections were formed and adjusting variables were used in analysis of covariance. The problem of concern here was the following: Are there differences in achievement between first semester freshmen chemistry students taught in a large lecture section and those taught in relatively small TV classrooms?

The students of each section were randomized into eight groups. Three groups were assigned to the large lecture hall where the television cameras were also located, and five groups were assigned, each to a different TV viewing room and taught over television. The number of students assigned to each TV room was proportioned to the number of useable seats in each room. This arrangement was held constant for four weeks or until the first examination.

Certain constant conditions were maintained. All students were supplied with lecture outlines which included chemical formulae and equations. Students were not permitted to change from assigned seats. Samples of chemicals to show color and color changes were provided when this was considered necessary for students in TV classrooms. The functions of the TV class assistants were defined as the taking of attendance records, maintaining order, and, when necessary, displaying chemical specimens.

The design outlined above was replicated in the second section.

Table 3 shows the results of an analysis of covariance of scores made on the first test by students in Section 1 in the direct and TV groups. Scores on the Test of Developed Abilities in Science were used as the adjusting variable.

TABLE 3

SUMMARY OF RESULTS OF DIRECT AND TELEVISED INSTRUCTION ON FIRST TEST IN GENERAL CHEMISTRY FALL 1955 (SECTION 1)

Source	*SS*	*df*	*V*	*F*	*p*
Treatments	82.21	1	82.21	.33	>.05
Error	67525.30	273	247.35		
Total	67607.51	274			

Adjusted Means Direct 83.49 (N = 131) TV 83.03 (N = 145)

Table 4 shows the results of an analysis of covariance of test scores made by Section 2 with the same adjusting variable.

TABLE 4

SUMMARY OF RESULTS OF DIRECT AND TELEVISED INSTRUCTION ON FIRST TEST IN GENERAL CHEMISTRY FALL 1955 (SECTION 2)

Source	*SS*	*df*	*V*	*F*	*p*
Treatments	32.00	1	32.00	.127	>.05
Error	77795.82	309	251.77		
Total	77827.82	310			

Adjusted Means Direct 83.33 (N = 159) TV 83.60 (N = 153)

It can be observed from these tables that the adjusted mean scores made by both TV experimental groups and both control groups are almost identical. The results of these analyses of covariance support the conclusion of the previous semester's experiment that there were no important differences in test scores made by freshmen chemistry students when taught over television compared with students taught directly. This conclusion is based on the lecture-demonstration part of the chemistry course. In addition, conventional recitation-discussion and laboratory exercises were important parts of the course. Furthermore, the textbook was strongly emphasized and was used by all groups.

Comparison of Direct and Televised Instruction in Elementary Business Law

The experiment in Elementary Business Law was conducted to determine the effects of the rotation of students between the originating room with direct instruction, and classrooms with televised instruction. The primary purpose was to study attitudes toward televised instruction and their relation to varied experiences. Comparisons were also possible on achievement test scores.

The course in Elementary Business Law was taught by an experienced lecturer whose lecturing style was dramatic and forceful. Strong emphasis was given to detailed and systematic study of the textbook which had been written by the instructor.

Several sections of the course were scheduled. Only one section was taught by television. The number of students registered in the TV section of the course was 189. These students were randomized into four groups. One group of 42 students was assigned for four weeks to the large classroom where the lecturer originated the instruction. A second group of students was assigned for two weeks to TV classrooms followed by two weeks in the originating room. A third group had instruction in the originating room first and TV instruction second (these two groups totalled 102 students). The fourth group consisting of 45 students was assigned for four weeks to TV classrooms. At the end of four weeks all students were given a common examination.

Table 5 gives the results of the examination after four weeks of the course. An analysis of variance was used to evaluate the results. In the analysis, groups two and three which had been rotated were combined.

TABLE 5

Summary of Results on First Examination in Elementary Business Law

Source	*SS*	*df*	*V*	*F*	*p*
Treatments	184.60	2	92.30	.77	>.05
Error	22226.62	186	119.50		
Total	22411.22	188			

Means Orig. R. 76.19 (N = 42), Rotating 75.87 (N = 102), TV 78.27 (N = 45)

The results do not show statistically significant differences between test scores made by students who were taught directly and scores of those taught over television. There were no effects on achievement scores resulting from rotation from the TV to the originating room.

At the conclusion of this first experiment in Elementary Business Law, the group which had been in the TV originating room was moved to a TV receiving room for the next four weeks, the group in the TV room was moved to the originating room for four weeks, and the other two groups continued their two weeks' rotation cycle. Thus, at the end of eight weeks, comparisons could be made between groups rotated fortnightly and those rotated monthly. Results of an analysis of variance are given in Table 6.

TABLE 6

Summary of Results on Second Examination in Elementary Business Law

Source	*SS*	*df*	*V*	*F*	*p*
Treatments	679.5	2	339.75	2.06	>.05
Error	30484.6	185	164.78		
Total	31164.1	187			

Means Orig. R. 76.72 (N = 47), Rotating 72.35 (N = 99), TV 72.79 (N = 42)

Comparisons of Direct and Televised Instruction in Introductory Sociology

The experiment in sociology in the spring of 1956 was designed to learn whether or not any differences existed between direct and televised instruction in terms of test measures on informational learning.

The instructor was a mature, vigorous and colorful lecturer. He presented his viewpoints forcefully and challenged stereotypical and traditional beliefs held by students, in order to instigate rational and objective analysis of social problems and human relations.

The section of the course made available for the experiment contained 279 students. These students were randomly divided into two approximately equal groups. One group was taught directly in a large lecture-hall originating room. The TV cameras were mounted in fixed positions in the fourth row of seats and class sessions were televised to the other group which was distributed in several TV receiving rooms. The method of operating television was the same as that used in 1955-1956.

Examination scores were analyzed in two ways: (1) the total test scores on questions covering both the textbook and lectures, and (2) test scores from questions taken from lectures alone. This was done in an attempt to differentiate to some extent the in-class and out-of-class learning.

Table 7 presents the results of the analysis of variance for the first examination and gives comparisons of achievement scores of students taught directly and over television. The differences were non-significant.

TABLE 7

SUMMARY OF RESULTS FOR FIRST EXAMINATION IN INTRODUCTORY SOCIOLOGY

Source	SS	*df*	*V*	*F*	*p*
Treatments	11.41	1	11.41	.45	>.05
Error	6957.15	275	25.30		
Total	6968.56	276			
Means	Direct 47.26 (N = 140)		TV 47.15 (N = 139)		

The analysis of scores on questions taken from the lectures was made in an attempt to deal with content which could be maximally influenced by television transmission and which could be least influenced by out-of-class reading and study of the textbook.

Table 8 gives the results of scores on questions taken from lectures.

TABLE 8

SUMMARY OF RESULTS FOR FIRST EXAMINATION IN INTRODUCTORY SOCIOLOGY (LECTURE ITEMS)

Source	SS	*df*	*V*	*F*	*p*
Treatments	24.75	1	24.75	2.32	>.05
Error	2722.26	255	10.68		
Total	2747.00	256			
Means	Direct 26.50 (N = 137)		TV 25.78 (N = 139)		

Table 9 presents the results of an analysis of variance of the total scores of the second examination.

TABLE 9

SUMMARY OF RESULTS FOR SECOND EXAMINATION IN INTRODUCTORY SOCIOLOGY

Source	SS	*df*	*V*	*F*	*p*
Treatments	13.46	1	13.46	.77	>.05
Error	4666.01	268	17.41		
Total	4679.47	269			
Means	Direct 48.51 (N = 138)		TV 48.06 (N = 132)		

Table 10 gives data and analysis of variance for the scores made on the lecture questions of the second examination.

Inspection of these results in all cases shows that there were no statistical differences in achievement as measured by informational tests between students taught directly and those taught over television.

TABLE 10

SUMMARY OF RESULTS OF SECOND EXAMINATION IN INTRODUCTORY SOCIOLOGY (LECTURE ITEMS)

Source	SS	*df*	*V*	*F*	*p*
Treatments	36.40	1	36.40	3.43	>.05
Error	2936.38	277	10.60		
Total	2972.78	278			
Means	Direct 23.45 (N = 138)		TV 23.18 (N = 132)		

Comparison of Direct and Televised Instruction in Elementary Meteorology

An introductory course in meteorology was proposed for experimentation during the Spring Semester 1956-1957. This is essentially a lecture-demonstration type of course. Comparisons were made between conventional and televised instruction.

Of approximately 241 students enrolled in the course, it was possible for 110 to keep two class periods open during registration; one hour as scheduled for TV instruction and a different hour as scheduled for direct or conventional instruction. Thus, 110 students could then be randomized between the two treatments at different hours and serve as subjects for the experiment. The rest of the members of each class were not counted as part of the experiment, although they were taught along with the experimental subjects.

This procedure of arranging for *experimental core populations* which could be randomized within much larger student populations permits necessary statistical controls in classes with large enrollments but for which randomization of all students is impossible or results in severe reductions in the number of students who could register for the course. This is an important procedural development, and extends the possibilities for experimentation in an academic setting.

Four especially prepared examinations, three tests and a final examination, were administered to all students. Product-moment correlation coefficients were computed on the odd-even items of scores for a sample of students on the first and third tests. The correlation coefficients were adjusted by the Spearman-Brown prophecy formula. The estimated reliability coefficient for the first test was .80 with an N of 132, and for the third test was .73 with an N of 119.

Table 11 gives the results for the first examination which was given after the first four weeks of the course. Two verbal ability sections of the Educational Testing Service's SCAT test were administered to all experimental subjects with the intention of using the combined scores on the two sections as an adjusting variable in an analysis of covariance of the results for the direct and televised instruction. However, the regression of the adjusting variable on the experimental variable was not significant in the first and the final examinations and thus did not permit application of covariance techniques. Therefore, t-tests of significance were used for the first and final examinations.

TABLE 11

SUMMARY OF RESULTS FOR FIRST EXAMINATION IN ELEMENTARY METEOROLOGY

Group	*N*	*Mean*	*t*	*p*
TV	53	76.57	.61	>.05
Direct	55	75.18		

Table 12 gives the results of the second examination with scores on the SCAT test being used as an adjusting variable in an analysis of covariance.

TABLE 12

SUMMARY OF RESULTS FOR SECOND EXAMINATION IN ELEMENTARY METEOROLOGY

Source	*SS*	*df*	*V*	*F*	*p*
Treatments	51.41	1	51.41	.27	>.05
Error	19974.06	105	190.23		
Total	20025.47	106			
Adjusted Means	Direct 61.43 (N=55)		TV 60.11 (N=53)		

Table 13 gives the results of the third examination with a covariance analysis again using combined part-scoring of the SCAT as an adjusting variable.

TABLE 13

SUMMARY OF RESULTS FOR THIRD EXAMINATION IN ELEMENTARY METEOROLOGY

Source	*SS*	*df*	*V*	*F*	*p*
Treatments	266.27	1	266.27	1.83	>.05
Error	15131.72	104	145.50		
Total	15397.99	105			
Adjusted Means	Direct 73.27 (N=55)		TV 70.11 (N=52)		

Table 14 shows the results on the final examination using t-test of differences between the control and experimental (TV) groups.

TABLE 14

SUMMARY OF RESULTS FOR FINAL EXAMINATION IN ELEMENTARY METEOROLOGY

Group	*N*	*Mean*	*t*	*p*
TV	49	81.34	1.06	>.05
Direct	54	83.35		

The results do not show significant differences between students taught directly and a comparable group of students taught over television by the same instructor at a different hour.

It may be observed that a small difference in means on the first examination favored TV while small differences on the second, third and final examinations favored direct or conventional instruction. As a further check, an analysis of the accumulated scores for the entire semester of both groups was made. Analysis of covariance was applied using the SCAT as a matching variable. Here too, the results were not statistically significant.

Comparison of Direct Teaching of a Large Class and Televised Instruction in General Psychology

Studies of the use of closed-circuit television have raised several important questions and this experiment in psychology, during the fall of 1956-1957, was designed to provide partial answers to these questions:

1. One realistic alternative to the use of closed-circuit television is the conventional procedure used in some universities of having superior, mature teachers lecture to large groups of 200 or more students in large lecture halls. The instructor may be provided with a good sound system and, if most of the information is communicated verbally and orally, large numbers of students can be taught directly, economically and perhaps effectively by one instructor. Furthermore, visual materials on films, motion picture or still, can be enlarged and projected. Direct demonstrations require large scale equipment and models. The availability of large and well planned lecture halls, however, is a necessary facility and if not available is a limiting factor in most universities. However, an important question is: How does instruction conducted in this general manner compare in measured effectiveness with similar instruction adapted and presented over closed-circuit television?

2. A problem which has evolved as a result of efforts to adapt courses for presentation over television is that when this is done, the course may become less suitable for direct presentation. For example, small objects, photographs and graphics, when developed can be effectively enlarged and projected over television, but the same materials in the same forms are almost useless for showing directly to large classes. Demonstrations and experiments with live subjects, especially children, can be presented from a TV originating room without an audience with much less interference than before a large class. Thus, adaptations of courses to television or for very large classes result in incompatabilities between the two approaches. Therefore, the question arises: What will be the result on the relative effectiveness of instruction if adaptations are made in course methods and materials to improve instruction both for television and for direct teaching of large classes (over 200 students)?

3. The experiment in psychology was designed to take into account a serious methodological problem: When direct teaching is compared with televised instruction and the students use textbooks which thoroughly cover the course materials, the study of the textbook by students may account

for most of the learning, particularly if, as is the general practice, the tests and examinations are based largely on textbook materials. Stated differently and hypothetically, the textbook may account for 80 to 90 percent of the learning gains made during the course, and hence only a 20 to 10 percent range would be available for the differential effects of the methods of instruction. Therefore, the question is: Would the elimination of a text for both the directly-taught group and the TV group make the experiment more sensitive for detection and measurement of possible differences?

4. Finally, measurements of academic achievement in courses, particularly the objective type tests, generally emphasize samplings of factual information and often seriously fail to measure the learning of principles, the understanding of complex concepts and their application, and complex perceptual-discriminatory learning. Therefore, every effort was made to improve tests by assigning a large part of the time of two very competent test construction experts to work with the instructors and attempt to build tests which would sample complex learning as well as factual learning, in an endeavor to answer the question of whether or not measurements of levels of complex learning in a course like psychology could be substantially improved.

During registration for the General Psychology course, two sections of students were scheduled, one with 392 students for Monday and Friday at 8: 00 a.m. and Wednesday at 1: 00 p.m. and one section with 183 students for Monday and Friday at 9: 00 a.m. and Wednesday at 2: 00 p.m. The first group was scheduled to be taught over television in seven different classrooms and the second was scheduled for direct instruction in a large lecture hall with elevated seats and a capacity for 400 students. The lecture hall (121 Sparks) was equipped with a moderately good sound system and projection facilities.

Within the total number of 575 students in both classes, 188 had both time sequences open, and hence could be randomized into either the television section or large classroom section. Ninety-five students were randomly assigned to television, and 93 students were randomly assigned to direct teaching. These students constituted the *experimental core* of subjects within the larger classes. It is important to know that the students in the experimental core were not aware of the fact that they were subjects in an experiment or that the results of their test scores were subjected to special treatment and analysis.

Students in both sections were treated alike in certain respects. All had the same carefully and especially prepared tests and examinations. Both classes were advised at the beginning of the course that no textbook would be required and that this would place a greater emphasis on class attendance, note taking, and, generally, on learning while in class. The intent was to have the maximum amount of instruction presented either over television or directly in lectures and demonstrations, including still and motion picture materials, thus permitting any differences in the effects of the two patterns of instruction to be expressed and measured.

The same experienced instructors taught both in the TV and directly-taught classes. First they met the television class, and then the large face-to-face class at the next hour, three days per week. Care was exercised to present the same subject matter to each class. Advantage was taken of the potentials of television, to a considerable extent, and adaptations were made on non-verbal instructional materials for presentation to the large class taught directly. For example, when a small chart or diagram was used on TV, a slide was prepared for projection in the face-to-face class.

An attempt was made to approach an optimum level in the general teaching methods, instructional materials and lecture styles adapted to the two different teaching situations.

It should be noted that the times when the two classes were scheduled differed by one hour and that the eight o'clock and one o'clock hours are generally believed to be less satisfactory to students than the nine o'clock and two o'clock hours. It is not possible without using kinescopic recordings to keep time constant in experiments like this and have the same instructors teach face-to-face and on TV simultaneously unless television is used to televise instruction from the large class, and when this is done, severe limitations are put on optimum employment of the medium.

Table 15 presents in summary form the results including the adjusting means, using the SCAT test as an adjusting variable, for the *experimental core* of subjects in the class taught directly and the class taught over television.

TABLE 15

SUMMARY OF RESULTS FOR EXAMINATIONS IN GENERAL PSYCHOLOGY

Test	*N*	*Direct Adjusted Mean*	*N*	*TV Adjusted Mean*
Exam 1	93	14.22	95	15.21
Exam 2	93	34.06	97	34.07
Exam 3	90	27.67	90	26.09
Final Exam	89	72.42	90	72.13
Mean total score for Semester	92	148.27	97	148.13

Table 16 gives the analysis of covariance on all examinations and total semester scores using the SCAT test as an adjusting variable.

These analyses show that test scores approach significance of differences favoring TV on the first test, and on the third test, scores favored the subjects taught directly at beyond the .05 level of significance.

The analyses illustrate the need for a plurality of examinations even though they are well prepared and reliable. Also, these analyses should indicate the need for caution in interpreting differences found on single tests.

TABLE 16

SUMMARY OF RESULTS FOR EXAMINATIONS IN GENERAL PSYCHOLOGY

	Source	SS	*df*	*V*	*F*	*p*
Exam 1	Treatments	43.06	1	43.06	3.80	>.05
	Error	2098.63	185	11.34		
	Total	2141.69	186			
Exam 2	Treatments	.01	1	.01	0.00	>.05
	Error	5330.20	187	28.50		
	Total	5330.21	188			
Exam 3	Treatments	112.75	1	112.75	6.39	<.05
	Error	3122.53	177	17.64		
	Total	3235.28	178			
Final Exam	Treatments	3.82	1	3.82	.07	>.05
	Error	9698.44	176	55.10		
	Total	9702.26	177			
Total score for Semester	Treatments	3.30	1	3.30	.01	>.05
	Error	41401.32	186	222.59		
	Total	41404.62	187			

Results. A summary of results relative to the basic questions raised follows:

1. When instruction in General Psychology was adapted for televising and compared with the same instruction adapted for large lecture hall presentation, comparisons of measures of student achievement showed no statistically significant differences. The accumulated average score over the semester was 148.27 for the large lecture hall class and 148.13 for the section taught by television.

2. Adaptations of teaching methods and materials to the conditions of direct and televised instruction did not produce measurable differences in the test and examination scores of students.

3. When students do not have a textbook, comparative results on achievement are relatively similar to experimental results obtained when students have a textbook.

4. The use of tests and examinations which were designed to measure learning of principles, understanding of complex concepts and problem-solving did not yield significant differences in comparative scores made by students in sections taught directly and by television.

Comparison of Direct and Televised Instruction in Music Appreciation

Music Appreciation had been taught over television for three semesters before it was possible to conduct an experiment with comparable groups of students taught by the same instructor at different hours. The excellent instructor in Music Appreciation had worked hard, within the limitations of materials available, to adapt his course for presentation over television. He had learned many of the necessary skills of TV teaching so it is very probable that a few unique factors were operative in this experiment. The course probably was not strictly "conventional" for it had undergone important changes for television and was being used appropriately for this medium.

The television and directly-taught experimental samples were made up from 90 students who had scheduling possibilities for either of two sequences. Televised instruction was given at 1: 00 p.m. on Mondays and Fridays and 8: 00 a.m. on Wednesday. Direct instruction was given on Mondays and Fridays at 9: 00 a.m. and Wednesday at 2: 00 p.m. Of the 90 students, 53 were randomized into the TV section and 37 into the section taught directly. These experimental core groups were taught along with 96 other students in TV viewing rooms and with 68 other students in a large classroom. All students in both sections were given the same course content and the same examinations. Test scores were used for comparative analysis from the experimental core groups only, which were randomly constituted.

A pre-test of music appreciation and information was given to both sections at the first meeting of the classes. Two examinations were given during the semester and each examination was in two parts, a factual information part and a listening part. The first factual test had an odd-even reliability of .74 as estimated by the Spearman-Brown prophecy formula.

Tables 17 and 18 give respectively the results of the listening and factual tests of the first examination. Analysis of covariance was done on each part using the pre-test as an adjusting variable.

TABLE 17

SUMMARY OF FIRST TEST OF LISTENING IN MUSIC APPRECIATION

Source	SS	*df*	*V*	*F*	*p*
Treatments	80.86	1	80.86	.66	>.05
Error	8760.35	71	123.39		
Total	8841.21	72			
Adjusted Means	Direct 82.77 (N = 31)		TV 84.57 (N = 43)		

TABLE 18

SUMMARY OF FIRST FACTUAL TEST IN MUSIC APPRECIATION

Source	SS	*df*	*V*	*F*	*p*
Treatments	6.28	1	6.28	.46	>.05
Error	9584.74	71	135.00		
Total	9591.02	72			
Adjusted Means	Direct 73.85 (N = 31)		TV 73.28 (N = 43)		

Table 19 presents the results for the factual and listening parts of the second examination. On each part, t-tests were used, and analysis of covariance was not used.

TABLE 19

SUMMARY OF SECOND EXAMINATION IN MUSIC APPRECIATION

Test	*TV Group N = 45 Mean*	*Directly Taught N = 29 Mean*	*t*	*p*
Factual	69.16	74.69	1.77	>.05
Listening	75.16	77.66	.75	>.05

The results of comparisons of the effectiveness of direct and TV instruction confirmed the findings of most of the other experiments; namely, no significant differences. This finding holds for Music Appreciation in spite of the considerable experience of the instructor with the medium and the fact that some adaptations had been made in the course to increase its suitability for presentation over television.

Brief Summary of Comparisons of Direct and Televised Instruction

Experimentation was continued during 1955-1956 and 1956-1957 to discover if there were differences in effectiveness between directly-taught and televised courses. Seven additional courses were studied. Retention studies with students in General Psychology showed no statistical differences in retention test scores for students taught directly and by television. Repetition of the 1955 experiments in General Chemistry, but with first semester freshmen, confirmed the previous results. No significant differences in test scores were found in Elementary Business Law among groups of students taught directly, those taught over television and those rotated between direct and televised teaching. The same absence of differences was found in Introductory Sociology, both for general course tests and for special tests on the lecture materials. Comparisons in Elementary Meteorology showed no significant test score differences for students taught directly and by television. When special adaptations were made in General Psychology both for television presentations and lecture-hall instruction, the semester's examination scores were almost identical. This resulted even though, for purposes of experimental control, students did not use a textbook in this course. Experiments with the course in Music Appreciation, which differed greatly from other courses studied, when taught directly and over television, once again yielded no significant differences in terms of measures of musical listening comprehension and factual information. Thus a general conclusion would seem to be in order:

Controlled experiments which compare direct and televised instruction with the same teachers teaching the comparison groups are unlikely to yield statistically significant differences in students' achievement scores when the courses, teachers and students are similar in those in the Penn State experiments.

Let us now consider experiments which deal with variables within the patterns of televised instruction.

COMPARISON OF DIFFERENT VARIABLES RELATED TO TV CLASS MANAGEMENT

Introductory Statement

The use of closed-circuit television in a university for teaching large numbers of students raises many questions about how TV sections should be organized and managed. Among these questions are the following: What are the effects of varying distances of students from television receivers of a given size? What are the relations, if any, between the number of students in a room and their academic achievement? Experiments were conducted in a number of courses during 1955-1956 to seek answers to these and other questions.

Closed-circuit television systems provide almost ideal instrumentation and conditions for controlled experimentation on the perplexing problem of class size. By using a television system, the same instructor(s) can present the same course content using identical methods at the same time of day to a number of classes which vary in size. Similarly, many other modifications and adaptations of televised instruction can be studied within the limitations imposed by the medium of television.

Effects on Achievement of Distance from Source of Instruction

General Chemistry. During the fall of 1955-1956 the problem of seating arrangements in a large classroom was studied. A reasonable alternative to using closed-circuit television for teaching large classes in different classrooms, as has been noted previously, is to teach large classes directly in large lecture-demonstration halls if these are available. When this latter plan is followed it is a plausible hypothesis that there exist zones of advantage and disadvantage in such large lecture halls. It is generally assumed that those students who have seats near the instructor are more advantageously positioned than those who have remote seats. This problem of distance from the instructor was investigated in General Chemistry.

A group of students was randomized into three sub-groups, A, B and C. Group A was seated in the front and center rows of seats, Group B was seated in the central middle section, and Group C was seated to the rear and in side areas of the auditorium where the instruction originated. After the first four weeks of the course students were examined. Table 20 gives the results of an analysis of covariance using the Test of Developed Ability in Science as an adjusting variable.

TABLE 20

SUMMARY OF RESULTS OF GROUPS SEATED AT VARIED DISTANCES FROM THE INSTRUCTOR FOR FIRST EXAMINATION IN GENERAL CHEMISTRY

Source	*SS*	*df*	*V*	*F*	*p*
Treatments	285.08	2	142.54	.63	>.05
Error	28775.72	127	226.58		
Total	29060.80	129			

Zones	*N*	*Adjusted Means*
A (front)	40	84.14
B (middle)	47	81.80
C (rear)	44	85.25

At the beginning of the fifth week 141 students who had been assigned to TV rooms for the first experiment were re-randomized into three groups, A, B and C, of 47 students each and assigned to the three zones of the large classroom as was done in the first experiment. Comparison of the scores of the three groups were made at the end of another five weeks. Table 21 gives the results using analysis of covariance with scores in the first examination as an adjusting variable.

TABLE 21

SUMMARY OF RESULTS OF GROUPS SEATED AT VARIED DISTANCES FROM THE INSTRUCTOR FOR SECOND EXAMINATION IN GENERAL CHEMISTRY

Source	*SS*	*df*	*V*	*F*	*p*
Treatments	1483.80	2	741.90	2.27	>.05
Error	44834.52	137	327.26		
Total	46318.32	139			

Zones	*N*	*Adjusted Means*
A (front)	47	74.45
B (middle)	47	73.93
C (rear)	47	81.08

The results of these experiments on the relation between distance of students from source of instruction, within the limits used (19 rows of seats), and achievement scores yield no statistical differences. In fact, Group C which was assumed to be disadvantageously seated, made higher mean scores in both cases, but the differences were not significant. Later it will be shown that distance from source of instruction *did* influence behavioral choices of students in selecting direct or televised instruction.

Of course it is obvious that when distances from the source of instruction become great enough, e.g., perhaps beyond 24 rows of seats, this will begin to produce a gradient decrement in the achievement or learning of students.

General Psychology. An experiment was conducted on the effects of distance from source of instruction in General Psychology during the Fall Semester of 1955-1956. An important difference between the psychology and the chemistry experiments was that in the psychology course distance from source of instruction was studied in terms of distance from four 24″ television receivers lined up across the front of an auditorium.

The problem in this experiment was to determine the effects on achievement, if any, of seating students within 12 screen widths (21′) from the four receivers as compared with achievement of students who were seated beyond the 12 screen widths' distance (21′ to 35′ from the receivers), in a zone of presumed disadvantage.

The selection of 12 screen widths as the cutting point was based on earlier research by the Instructional Film Research Program at the Pennsylvania State University in which it was found that the learning of an assembly task from films was adversely affected if students sat beyond twelve screen widths from a small rear projection screen.[1]

No differences in test scores were found related to distance from receivers within the limits of space used.

Summary. Studies were made of the effect on student achievement of distance from source of instruction in the lecture-demonstration portions of a chemistry course with direct instruction and in a psychology course with televised instruction. No relations were found between distance from instructional source within limits tested, and students' examination scores. The inference is that large enough distances were not tested to find the limits of perception beyond which learning would be affected. It is reasonable to infer, also, that for students remotely seated, size constancy and other psychologically compensating mechanisms operated.

EFFECTS ON ACHIEVEMENT OF VARIED CLASS SIZE IN TV CLASSROOMS

General Chemistry. A study was made also in the General Chemistry course on the relation between the number of students in TV classrooms and their test scores in two examinations. Students were divided into two groups, one of which met in various TV classrooms, and the other in a large lecture hall.

From the first group, five sub-groups were randomly constituted and assigned to five TV classrooms with the number

1. Ash, P. & Jaspen N., "Optimum Physical Viewing Conditions for a Rear Projection Daylight Screen," Technical Report SDC 269-7-37, The Instructional Film Research Program, Pennsylvania State University, 1953.

of students in each ranging from 14 to 43. Students were seated in favorable positions relative to 24" television screens. The rooms were not filled.

Table 22 gives the results for the first examination using the Test of Developed Ability in Science as an adjusting variable.

TABLE 22

SUMMARY OF RESULTS FOR VARIED CLASS SIZE IN FIRST EXAMINATION IN GENERAL CHEMISTRY

Source	SS	*df*	*V*	*F*	*p*
Treatments	731.09	4	182.77	.69	>.05
Error	37041.20	139	266.48		
Total	37772.29	143			

Class Size	*Adjusted Means*
43	81.36
36	86.44
31	81.22
21	81.93
14	85.74

Following the first examination the two groups reversed positions and the experiment was repeated with 130 students who had previously been in the large lecture hall. As before, the students were randomized into five sub-groups with sizes ranging from 11 to 44 and assigned to the same rooms used in the first experiment.

TABLE 23

SUMMARY OF RESULTS FOR VARIED CLASS SIZE ON SECOND EXAMINATION IN GENERAL CHEMISTRY

Source	SS	*df*	*V*	*F*	*p*
Treatments	2492.57	4	623.15	1.68	>.05
Error	45766.08	124	369.08		
Total	48258.65	128			

Class Size	*Adjusted Means*
44	77.97
32	76.26
22	66.29
21	74.00
11	68.56

Table 23 presents the results of an analysis of covariance on this second test with scores on the first examination being used as an adjusting variable.

The results of both experiments show no statistically significant relation between class sizes, within the limits used, and learning as indicated by examination scores in chemistry.

General Psychology. This experiment was conducted with two TV sections of psychology. Two hundred and seventy students were enrolled in Section 1 and 261 in Section 2. The students in each section were randomized into five groups and taught via TV for the first one-third of the semester or until the first examination. Class size was varied from 21 to 119 students.

Table 24 gives the mean scores and numbers of students in each TV class for both sections on the first examination.

TABLE 24

SUMMARY OF RESULTS FOR VARIED CLASS SIZE ON FIRST EXAMINATION IN GENERAL PSYCHOLOGY

Section 1		*Section 2*	
Class Size	*Mean*	*Class Size*	*Mean*
119	36.82	109	37.07
49	36.41	49	36.22
46	35.57	49	36.94
35	36.26	35	37.51
21	34.00	19	35.68

Analysis of variance gave non-significant values of $F = 0.88$ for Section 1 and $F = 0.45$ for Section 2. Another examination at the end of the second third of the semester was given to Section 2 for classes with 19, 33, 46, 46 and 86 students randomly assigned to separate rooms. The mean scores for the second third of the semester varied less than one point. Analysis of covariance using the first examination as an adjusting variable yielded a non-significant value of $F = 0.11$.

Thus in psychology as in chemistry no statistically significant relationship was found between TV class size and scores on carefully prepared objective examinations.

Air Science. Air Science is an Air Force ROTC course which provides basic military instruction to first and second year cadets. Enrollment in the TV section available for experimentation was 369 students. These were randomly distributed into six TV classes with the number of students varying over a range from 19 to 110. The students were taught in these classes over television for three weeks and then given an examination. An analysis of covariance was

carried out. There were no statistically significant differences in informational learning related to variation in class size. Table 25 presents a summary of the analysis of covariance results.

TABLE 25

SUMMARY OF THE EFFECTS OF VARIED CLASS SIZE ON THE FIRST EXAMINATION SCORES IN AIR SCIENCE

Source	*SS*	*df*	*V*	*F*	*p*
Treatments	100.73	6	16.79	1.07	>.05
Error	4465.21	285	15.67		
Total	4565.94	291			

Class Size	*Adjusted Means*
19	26.73
24	25.90
25	27.35
30	27.18
42	28.05
43	28.07
110	27.38

Principles of Economics. The course in Principles of Economics was taught in two lecture sessions over TV and one discussion session per week. The lectures were given by a professor of considerable experience.

The 144 students enrolled in economics were divided randomly into five classes which varied in size from 14 to 41. During the first half of the Fall Semester of 1955 two examinations were given to the class. Table 26 gives the means of the combined scores on these two tests for each of the TV classes.

TABLE 26

SUMMARY OF RESULTS FOR VARIED CLASS SIZE IN PRINCIPLES OF ECONOMICS

Class Size	*Means of Combined Scores*
41	144.85
37	136.81
28	140.07
24	139.63
14	136.86

Analysis of variance gave an F of less than 1.00. Once again no significant relation was found between varied TV class size and test scores.

Music Appreciation. One final experiment was conducted on the relation of TV class size to achievement. Music Appreciation differed in character from all other courses used in this line of research in that it was in the field of the arts. It was well taught with visualization and emphasis on the historical developments of music, information about composers and musical instruments with illustrations of musical selections by means of recordings. Thus, learning demands on students were somewhat different from chemistry, psychology, air science and economics.

The Music Appreciation TV section had 237 students enrolled in the Fall Semester of 1955-1956. These students were randomized into five classes and assigned to different TV classrooms. A pre-course test and two examinations were given, each consisting of a factual part, and a listening or music-identification part. After the first examination the groups were re-randomized. Tables 27 through 30 give the results of the analyses of the examination scores.

Table 27 gives the results on the factual part of the first examination using scores on the pre-test as an adjusting variable.

TABLE 27

SUMMARY OF RESULTS ON VARIED CLASS SIZE IN FACTUAL PART OF FIRST EXAMINATION IN MUSIC APPRECIATION

Source	*SS*	*df*	*V*	*F*	*p*
Treatments	1847.61	4	461.90	5.92	<.05
Error	18032.28	231	78.06		
Total	19879.89	235			

Class Size	*Adjusted Means*
92	78.72
49	83.43
48	75.23
33	81.70
15	80.24

The results of analysis of covariance show, for the first time, significant differences among the groups, but the differences are not systematically related to class size.

Table 28 gives the results of the listening part of the first examination again with the pre-test scores being used as an adjusting variable. Here the differences were non-significant statistically.

TABLE 28

SUMMARY OF RESULTS ON VARIED CLASS SIZE IN LISTENING PART OF FIRST EXAMINATION IN MUSIC APPRECIATION

Source	*SS*	*df*	*V*	*F*	*p*
Treatments	307.27	4	76.82	.53	>.05
Error	33634.90	231	145.61		
Total	33942.17	235			

Class Size	*Adjusted Means*
92	77.40
49	80.13
48	77.43
33	79.22
15	79.01

Table 29 gives the results of the factual part of the second examination using an analysis of variance.

TABLE 29

SUMMARY OF RESULTS ON VARIED CLASS SIZE IN FACTUAL PART OF SECOND EXAMINATION IN MUSIC APPRECIATION

Source	*SS*	*df*	*V*	*F*	*p*
Treatments	557.37	4	139.34	1.37	>.05
Error	23620.59	232	101.81		
Total	24177.96	236			

Class Size	*Means*
93	80.75
49	84.49
48	80.79
34	83.06
13	81.54

The differences on this test were not significant and did not support the apparent differences found on the factual part of the first examination, further confirming the lack of a relationship between achievement and class size.

Table 30 gives results on the listening part of the second examination with an analysis of variance.

TABLE 30

SUMMARY OF RESULTS ON VARIED CLASS SIZE IN LISTENING PART OF SECOND EXAMINATION IN MUSIC APPRECIATION

Source	*SS*	*df*	*V*	*F*	*p*
Treatments	2892.98	4	723.24	2.16	>.05
Error	77751.01	232	335.13		
Total	80643.99	236			

Class Size	*Means*
93	68.04
49	70.77
48	61.66
34	71.71
13	71.08

Once again no relationship was discovered between TV class size and test scores either on factual or listening-identification tests for students in Music Appreciation.

Summary. Studies were made of the class-size variable in General Chemistry, General Psychology, Air Science, Principles of Economics and Music Appreciation. In the tests given in all of these courses, with the exception of one test in Music Appreciation, no significant differences in test scores were found among the varied TV class sizes. Closed-circuit television made possible unusually good experimental controls. The practical implications are that TV class sizes can be greatly varied using single and multiple receivers without adversely affecting academic test scores. These results should not be over-generalized. The next phases of research on the distance from instructional source and varied class sizes should deal analytically with the relations between specific teaching and learning functions or operations and specific kinds of academic achievements of students.

EFFECTS ON ACHIEVEMENT OF OTHER VARIATIONS AND ADAPTATIONS IN TV COURSES

Introductory Statement

Once it has been decided to use closed-circuit television for teaching large classes, many problems and possibilities for adaptations need to be defined and explored relative to the question of how best to employ television for teaching. Generally, the problems relate to the adaptations and improvements in the management and conduct of courses. Television systems, when available as a teaching facility, both raise problems and provide a means of investigating perennial problems in class management. The main objective of research on variations and adaptations is that of determining the effects, if any, on academic achievements of students.

There are large numbers of problems and questions which could theoretically be defined and investigated. Since all of these cannot be studied at once, or in a limited time, those to be investigated must be selected and given priority. There are many factors which have affected the selection of problems for study at Penn State; among these are theoretical and practical considerations, the interests of research staff members and instructors, and the frequency with which certain problems are raised or criticisms expressed of TV instruction.

General areas which emerged for study are the following:

1. Effects of variation in the composition of TV classes.
2. Effects of different kinds and amounts of TV class supervision.
3. Effects of rotating students through TV and direct instruction.
4. Effects of different ways of providing opportunities for discussion and question-and-answer exchanges.
5. Effects of different kinds of out-of-class independent study opportunities and activities which supplement TV instruction.
6. Effects on achievement of variations in TV presentations.

Based on the assumption that the reactions of students to different methods of instruction may be important and provide useful evaluative information, these reactions, when sampled, will be reported for each course and method variation which was studied.

Effects of Variation in the Composition of Classes in Psychology of Marriage

The course in marriage was taught during the Fall Semester of 1955 by an experienced instructor, with 20 married or formally engaged couples in the originating room and the rest of the class of over 100 students distributed in TV classrooms. The lecture-discussion method was used principally with discussions taking place between the instructor and the selected originating-room group of students. It was expected that the maturity and interest of this group would promote effective discussions.

The instructor was interested in the question of whether it would be better to teach the marriage course in same-sex classes or different-sex classes. The research staff was interested in the effects of varied patterns of proctoring on TV classes, and the possible differences between required and voluntary attendance.

Twenty students were selected to form the group for the originating room. The remainder of the class was randomly assigned to four TV classrooms: an all-male class of 25, an all-female class of 24, a mixed-sex group of 24, and a non-experimental group of all of the excess males.

A factual pre-test was given to all students and the results of this test were used as an adjusting variable for the experimental classes.

The first examination was given and the results analyzed using an analysis of covariance with the pre-test scores as an adjusting variable. Table 31 presents the results.

TABLE 31

SUMMARY OF RESULTS FOR SAME-SEX VERSUS MIXED-SEX GROUPS FOR COMBINED SCORES OF THE FIRST AND SECOND EXAMINATION IN PSYCHOLOGY OF MARRIAGE

Source	*SS*	*df*	*V*	*F*	*p*
Treatments	80.31	2	40.16	.60	>.05
Error	4577.43	69	66.34		
Total	4657.74	71			

Class	*N*	*Adjusted Means*
All-male	25	84.96
All-female	24	84.96
Mixed Sex	24	83.38

An analysis of variance was made on the combined scores of the third and fourth examinations. Table 32 gives the results.

TABLE 32

SUMMARY OF RESULTS FOR THIRD AND FOURTH EXAMINATIONS (COMBINED) IN PSYCHOLOGY OF MARRIAGE

Source	*SS*	*df*	*V*	*F*	*p*
Treatments	138.73	2	69.36	.86	>.05
Error	7122.82	88	80.94		
Total	7261.61	90			

Class	*N*	*Means*
All-male	29	84.10
All-female	31	86.48
Mixed Sex	31	83.71

It is clear from these results that the controlled variations in the composition of TV classes for the course in Psychology of Marriage made no differences in the measured achievements of students.

Reactions of Students to Same and Mixed-Sex Class Composition. The class was surveyed at the end of the semester for their expressed preferences for the different class arrangements. Of 102 students, 68 percent preferred mixed groups, 30 percent reported that there was no difference and only 2 percent preferred same-sex classes for the course in marriage. Both males and females favored mixed-sex classes. Neither sex reported embarrassment in mixed-sex groups when topics of sexual adjustment were discussed.

Effect on Achievement of Massed Class Compared with Distributed Classes in Introduction to Education

Closed-circuit television can be employed as an auxiliary instructional instrument for magnifying visual materials and showing close-ups of other instruction in large lecture halls with a large class, or as a device for distributing instruction to dispersed classrooms in the same or different buildings. The former condition is termed "massed" and the later condition "distributed" with reference to classes in this experiment.

The experiment conducted in Introduction to Education during the spring of 1957 was designed to compare the following two conditions:

1. A class of 89 students was taught in a large lecture hall. The instructor taught the class directly and used a closed-circuit system to project and magnify visual materials including a large number of charts on six receivers arranged for good student visibility throughout the lecture hall. Actually many students being taught under this condition had several choices of viewing visual materials: directly, or on one or more TV receivers, or both, by shifting attention from one presentation possibility to another.

2. Instruction, which was the same as that given under the condition described above, was originated in a small room without students and televised to five TV classrooms accommodating a total of 113 students.

Students were encouraged to ask questions in the large class taught directly, and the same encouragement was given students in TV classrooms to ask questions over a two-way microphone system.

During registration it was possible to randomize a total of 113 students into the two comparison groups. These were assigned to two sections which met on successive periods, three periods per week, under the two conditions described above. There were 48 randomly assigned students in Section 1, and 65 in Section 2, and these constituted the experimental core of subjects.

Two measures were used for comparison purposes, a mid-semester score combining evaluations of tests, exercises and papers, and a similar score at the end of the semester.

Tables 33 and 34 give the results for students' mid-semester and final scores, using t-tests.

TABLE 33

SUMMARY OF RESULTS COMPARING MEAN ACHIEVEMENT SCORES FOR MASSED AND DISTRIBUTED CLASSES AT MID-SEMESTER IN EDUCATION

Treatment	*N*	*Means*	*Sm*	*t*	*p*
Massed Class with TV	48	70.39	1.58	.21	>.05
Distributed TV Classes	64	70.81	1.22		

TABLE 34

SUMMARY OF RESULTS COMPARING MEAN FINAL SCORES FOR MASSED AND DISTRIBUTED CLASSES IN EDUCATION

Treatment	*N*	*Means*	*Sm*	*t*	*p*
Massed Class with TV	47	368.85	7.28	1.51	>.05
Distriubted TV Classes	65	354.91	5.65		

The mean scores for the two groups at mid-semester were not significantly different. Final mean scores for the massed class, with television being used as an auxiliary projection-magnifier, also were not significantly different compared with the distributed TV classes.

Effects of Varied Amounts of Supervision in TV Rooms for General Psychology

The problem of the effect on achievement of three different amounts of supervision in TV classrooms was studied in General Psychology during the middle third of the Fall Semester of 1955.

More than 200 students were randomly distributed into five classrooms under one of the three following conditions:

1. No supervision, except that a teaching assistant recorded attendance in each of two different classrooms and then left the room.

2. Partial supervision by a teaching assistant who monitored the class and recorded attendance during one-half of each class period in each of two different TV classrooms.

3. Full-time supervision by a teaching assistant who recorded attendance and was always present during each full class period.

In the above situations the proctors recorded attendance and exercised supervision only to the extent of controlling

TABLE 35

SUMMARY OF RESULTS FOR VARIED AMOUNTS OF SUPERVISION IN GENERAL PSYCHOLOGY

Room	*Treatment*	*N*	*Adjusted Mean Score*
A	Proctor taking attendance only	41	43.90
B	Proctor taking attendance only	21	43.40
C	Proctor spends 50% of time in room	89	43.67
D	Proctor spends 50% of time in room	37	44.16
E	Proctor there all the time	39	43.90

student behavior that might interfere with other students' hearing and seeing the presentations. They did not conduct discussions.

Table 35 presents the adjusted mean scores for the three conditions and five different rooms.

Analysis of covariance using scores in the earlier examination as an adjusting variable gave $F = 0.65$ which is not statistically significant. Thus, there is no evidence for the need and justification of providing proctors for college students in a General Psychology course when the role of the proctor is merely that of "keeping order," being present and recording attendance.

Effects of Supervision and Required Versus Optional Attendance on Absenteeism in Psychology of Marriage

In the Psychology of Marriage course following the study of same versus mixed-sex groups the TV classes were re-randomized into three mixed-sex classes. For the first class there was no proctor present during the class periods. Although attendance records were taken, the students were told that their attendance would be entirely on an optional basis. For the second class a proctor was present in class but attendance was also optional. For the third class, a proctor was present and attendance was required. Students in this third class were told that unexcused absences would be subject to University regulations and that such unexcused absences would affect their grades.

Table 36 gives the results on recorded attendance with actual absences expressed as a percentage of total possible absences for the period.

TABLE 36

Summary of Results Showing Absenteeism after Mid-Semester in Psychology of Marriage

Class Sections	*Treatment*	*Absences*
First	No Proctor, optional attendance	11.33%
Second	Proctor, optional attendance	9.96%
Third	Proctor, compulsory attendance	10.91%

By inspection we see that the different arrangements had no very important effects on class attendance. These findings suggest that it may be unnecessary to provide proctors for TV classrooms for some kinds of college students and courses when the principal functions of the proctors are to keep order and take attendance records. It is probably advisable to develop in college students the ability to accept responsibility for attending class and for classroom behavior.

Effects of Varied Statuses of Proctors in TV Classrooms for Air Science

The teaching of military courses like Air Science provides opportunities for trainees to exercise leadership responsibilities in academic situations. Also, opportunities may be arranged for cadet classes to accept responsibilities for discipline. At the same time some classroom duties usually performed by officer instructors presumably can be performed by trainees themselves, thus reducing the requirements for officer-instructor personnel.

The problem of determining the effects on achievement of the varied statuses of TV classroom proctors was studied in Air Science during the Fall Semester of 1955.

Experimental groups were composed by randomizing 124 cadets into four classes with 31 students in each group. Three different classes were supervised by the following kinds of proctors: (1) a commissioned officer of the Air Force ROTC staff, (2) a cadet officer, (3) a peer class member who was chosen at random within each peer-proctored class. The fourth class had no proctor, had attendance taken at the beginning of the class period by the experimenter and were then left alone.

The instruction was given for three weeks under conditions outlined above with all other variables held constant for all four TV classes.

At the end of the three-weeks' period two forms of an especially prepared achievement examination were administered to the students. Reliability coefficients of the two forms computed by the Kuder-Richardson formula 20 were .79 and .81. At the same time reactions of students to televised instruction were assessed with the assumption that differences in proctoring arrangements might be reflected in student attitudes toward the instruction being televised.

Analysis of results shows no differences either in achievement scores or reactions to variations in the statuses of proctors. Thus, it may be inferred that for military courses it may be both feasible and desirable, in terms of training values, to have cadet groups assume the responsibility for their own behavior and to carry out the requirements of class discipline including attendance. As a result of this experiment, the Air Science course at Penn State has adopted the self-proctoring system and put cadets on an honor system for class attendance. The procedure is very satisfactory.

Effects on Achievement and Reactions of Students to Direct Instruction, Televised Instruction and Rotation in Elementary Business Law

Effects on Achievement. Large classes may be managed and organized in such a manner as to provide simultaneously direct instruction to a class, televised instruction, and various schedules of rotation of students between direct and televised instruction.

The instructor in Elementary Business Law during the Fall Semester of 1955 expressed two strong preferences: (1) for originating the TV presentation with a large face-to-face class, and (2) for providing a schedule that would permit all students at some periods during the semester to have direct instruction from him in the originating classroom. The instructor agreed to cooperate in an experiment on the effects of rotating students through the originating room.

Three conditions were arranged by randomizing 189 students into four groups. One group was taught for the entire four weeks in a large lecture hall from which the instruction was televised. The second and third groups spent two weeks in TV classrooms and then two weeks in the large originating room. The fourth group received instruction for four weeks in a TV classroom. At the end of four weeks all students were given a common examination.

TV classrooms were proctored mainly for disciplinary purposes. Attendance records were often taken with considerable annoyance to students while the lecture was being given over television. An analysis of variance of the scores on the first examination was performed.

Table 37 gives the results for the three groups at the end of four weeks.

TABLE 37

SUMMARY OF RESULTS FOR FIRST EXAMINATION IN ELEMENTARY BUSINESS LAW

Source	SS	*df*	*V*	*F*	*p*
Treatments	184.60	2	92.30	.77	>.05
Error	22226.62	186	119.50		
Total	22411.22	188			
Means	Direct 76.19 (N = 42) Rotated 75.87 (N = 102) TV 78.27 (N = 45)				

The differences were not significant. The experiment was continued for another four weeks. The group taught directly changed places with the TV group. The other students continued to rotate between the originating room and TV classrooms every two weeks. At the end of another four weeks all students were given a second common examination.

Table 38 gives the results of an analysis of variance.

TABLE 38

SUMMARY OF RESULTS FOR SECOND EXAMINATION IN ELEMENTARY BUSINESS LAW

Source	SS	*df*	*V*	*F*	*p*
Treatments	679.51	2	339.76	2.06	>.05
Error	30484.60	185	164.78		
Total	31164.11	187			
Means	Direct 76.72 (N = 47) Rotated 72.35 (N = 99) TV 72.79 (N = 42)				

Measures of achievement on the two examinations showed no statistical differences among the three conditions of this experiment.

Reactions of Students to Rotation. As a part of the evaluation program in Elementary Business Law an attempt was made to measure the attitude of the students toward instruction by means of closed-circuit television at the end of the first four weeks and again at the end of the semester. This was necessary in order to gain some measure of the effect of the rotation conditions relative to attitude toward the course. The rotation schedule gave students a good basis for making judgments about direct and televised instruction. Therefore, the following statement was presented at the end of the first four weeks and again at the end of the semester to all students who had experienced television in this course.

After having participated in a TV section I find that I:

5 enjoy it very much
4 enjoy it somewhat
3 have no particular feelings about it
2 dislike it somewhat
1 dislike it intensely

The responses of the students to this statement were recorded using the numerical system listed above. The attitude statement was broken down into three main categories: positive (consisting of the number five and four responses); neutral (consisting of the number three responses); and negative (consisting of the two and one responses). The frequency counts were then converted into percentages.

The responses of the two sections that were rotated every two weeks (these were combined since both experienced similar conditions), and the section that experienced TV only for the first four weeks and then was rotated are shown in Table 39.

A frequency count was then made for matched responses, i.e., only those data were used where the student responded to both presentations of the attitude statement. This method of treating the data accounts for the attrition in population for this survey.

TABLE 39

REACTIONS OF STUDENTS TO TELEVISED INSTRUCTION IN ELEMENTARY BUSINESS LAW

	Rotated every 2 weeks N = 87		*TV first 4 weeks then rotated N = 41*	
	Reactions		*Reactions*	
Responses	*4 Weeks*	*End Term*	*4 Weeks*	*End Term*
Enjoy TV somewhat plus enjoy it very much (combined)	21%	25%	37%	59%
Have no particular feelings toward TV	18%	8%	19%	5%
Dislike TV somewhat plus dislike it intensely (combined)	61%	67%	44%	36%

Several observations and inferences can be made about these data:

(1) Generally, the indicated reactions to TV instruction are among the least favorable ever obtained at Penn State.

(2) The group which had TV instruction continuously for the first four weeks was relatively most favorable to this mode of presentation.

(3) Individuals of all treatment groups in the category of "no particular feelings" shifted either toward the positive or negative direction of the scale during the semester, i.e., their attitudes apparently became more structured and strongly activated. Finally, the results of this survey of verbal reactions should be compared with behavioral choice responses for Elementary Business Law reported in Chapter 4 on p. 75 which resulted in 42 percent choosing to receive instruction for the rest of the semester over television.

Effects on Achievement of Varied Provisions for Discussion and Question-Answers

Introductory Statement

Probably the most frequent criticism of instructional television is that its use prevents, or severely limits, opportunities for discussions between students and teachers. The implicit assumption, basic to this criticism, is that discussion importantly contributes to academic achievement. The position also seems to assume that discussion-teaching is superior to the lecture-demonstration method. Furthermore, discriminations are rarely made as to the efficacy of different methods relative to different instructors, course contents, specific educational functions, course objectives and kinds of students. These assumptions about discussion methods need to be investigated analytically apart from but also in conjunction with the use of closed-circuit television.

Given the assumptions made by many educators about the value of class discussions, the question arises of whether or not the management of TV sections can and should be arranged to include opportunities for class discussion.

There are a number of possibilities of providing for discussion. If the TV lecture can be limited to 35 minutes to allow the last 15 minutes of the 50-minute period for discussion, then within this pattern several alternatives follow:

(1) The instructor may hold a discussion with a representative group of students in the originating room with all other students of a large section distributed in TV classrooms. Students in TV classrooms may listen to discussions with "vicarious" but not overt participation.

(2) The discussions may be conducted by faculty members, graduate assistants or undergraduate discussion leaders with the students in TV classrooms. The principal instructor may take one of the discussion groups or visit one or more TV classes each period.

(3) An alternative programming might be to schedule TV lectures for two entire 50-minute periods followed later in the week by special discussion and problem-solving sessions. Here again the two methods of discussion listed above may be used. In addition, the principal instructor and his assistants may hold informal conferences outside the TV classrooms with groups of students for discussions and for solving problems.

The expressed need for informal discussion relates closely to the expressed need for a question-answer period between an instructor and the students in TV classrooms.

Effects on Achievement of Varied Discussion Methods in General Psychology

During the Fall Semester of 1955, an experiment was planned for studying several different patterns for providing discussion opportunities in General Psychology. The following conditions were arranged:

A. The main lecture was limited to 35 minutes and the following period of 15 minutes was used for discussions in TV classrooms with graduate student leaders. The principal instructor framed his lecture to provide a basis for discussion and sometimes proposed "starter" questions.

B. The principal instructor gave a 35-minute lecture and, during the remaining 15 minutes, conducted a discussion based on the lecture with eight students who were in the originating room. Students in TV classrooms studying under this condition listened to the discussion ("vicarious participation") but they did not take an overtly active part in the discussion.

C. Students under this condition were given the choice of leaving the class or of remaining and studying their notes or the textbook. They neither heard nor took part in the discussions.

The experiment was conducted during the last third of the Fall Semester of 1955 and was completely replicated with a second TV section of General Psychology which met the following hour.

Table 40 presents the mean scores and analysis of variance for TV Section 1.

TABLE 40

Summary of Results of Varied Discussion Groups for Section 1 of General Psychology

Source	*SS*	*df*	*V*	*F*	*p*
Treatments	109.85	2	54.92	1.43	>.05
Error	10780.05	280	38.50		
Total	10889.90	282			

Treatment	*N*	*Means*
A. Listened to Discussion	188	42.12
B. Asst. Led Discussion in TV Classroom	56	42.09
C. No Discussion	39	40.31

Table 41 gives the mean scores and the analysis of variance for Section 2.

TABLE 41

SUMMARY OF RESULTS FOR DIFFERENT DISCUSSION GROUPS FOR SECTION 2 OF GENERAL PSYCHOLOGY

Source	*SS*	*df*	*V*	*F*	*p*
Treatments	136.13	2	68.06	1.74	>.05
Error	10316.42	264	39.08		
Total	10452.55	266			

Treatment	*N*	*Means*
A. Listened to Discussion	175	41.45
B. Asst. Led Discussion in TV Classroom	52	43.06
C. No Discussion	39	42.79

The analyses of examination scores for both TV Sections 1 and 2 revealed no significant differences in achievement scores related to the discussion conditions compared in the experiment. Those students who were free to use the last 15 minutes of the class period as they chose, made scores on examinations similar to those who listened to an instructor-led discussion or took part in a graduate assistant-led discussion. This was true even though, in the interest of the experiment, terminating the lectures after 35 minutes and giving students the choice of studying or leaving the room stimulated negative attitudes on the part of some students. Nevertheless, they did as well as the others who had the discussion treatments. This experiment raises the question of whether or not 50-minute class periods are necessary for all college courses.

Reactions of Students to Varied Discussion Groups in TV Sections of General Psychology. Reactions of students to the discussion procedure were surveyed both for the groups who only observed over TV and for those who actually took part in discussions led by graduate assistants.

Students were asked to check one of the items on the following 5-point scale: "What is your reaction to the 35-minute lecture followed by a 15-minute discussion period begun during the latter part of the course?"

5 Extremely favorable
4 Somewhat favorable
3 Have no particular reaction
2 Somewhat unfavorable
1 Extremely unfavorable

Tables 42 and 43 give the mean scores and analysis of variance on the attitude of students to varied discussions.

TABLE 42

SUMMARY OF STUDENT REACTION TO VARIED DISCUSSION METHODS IN SECTION 1 OF GENERAL PSYCHOLOGY

Source	*SS*	*df*	*V*	*F*	*p*
Treatments	10.52	1	10.52	7.45	<.05
Error	317.72	225	1.41		
Total	328.24	226			

Treatment	*N*	*Mean*
Viewed Discussion on TV	174	2.79
Participated in Live Discussion	53	3.30

TABLE 43

SUMMARY OF STUDENT REACTION TO VARIED DISCUSSION METHODS IN SECTION 2 OF GENERAL PSYCHOLOGY

Source	*SS*	*df*	*V*	*F*	*p*
Treatments	19.85	1	19.85	11.87	<.05
Error	357.91	214	1.67		
Total	377.76	215			

Treatment	*N*	*Mean*
Viewed Discussion on TV	165	2.93
Participated in Live Discussion	51	3.65

The results indicate that students strongly preferred to participate in live discussions held in classrooms rather than listening to and observing discussion on TV between the principal instructor and a small group of eight students in the originating room.

There were some informal and general observations gathered relative to the different methods of providing for discussion:

(1) Instructors who were used to 50-minute lecture periods judged that they were "too rushed" and could not adequately "cover the materials" in the 35-minute period.

(2) The lectures were largely conventional and consisted primarily of presenting information. The lectures were not especially designed to raise problems and provide provocation for discussion.

(3) The personality of students invited to represent the class in the originating room surely had an effect on discussions and the reactions of students in the TV rooms. Several of the students in the originating room were unfortunate

representatives either because they "talked too much", insisted on defending their prejudices, and wasted time on minor points, or they did not effectively participate in the discussions nor represent the questioning needs of other students.

(4) The microphone pick-up and transmission of student questions and comments in the originating room were not entirely satisfactory at the time this work was done. The split period arrangements as tested, therefore, seem to have potentialities which were not fully exploited by the experiment reported above. Improvements can be made.

Effects on Achievement of Question-Answer Procedures in Principles of Economics

During the first four weeks of the Spring Semester of 1957 the value of question-answer procedures was investigated in Principles of Economics. The 260 students were randomized into two groups and each group was assigned to three TV classrooms. All TV classrooms for one group were equipped with a question-answer, "talk-back" or "two-way" communication system. The three TV classrooms for the other group had no question-answer system. Students in rooms with question-answer systems were encouraged to use a portable microphone to ask questions of the principal instructor (See description of equipment Chapter 3, pp. 47-49). Students in the other three rooms could hear students' questions and hear and see as the instructor replied but could not themselves ask questions; their participation in the question-answer processes might be termed "vicarious". All groups received two televised lectures per week, plus one recitation period led by graduate students with visits by the principal instructor.

After four weeks, a common examination consisting of true-false, matching, and multiple-choice questions was administered to all students. Two forms of the examination were used and distributed to students in alternate seats.

The t-tests and scores are reported below in Table 44 for both forms of the examination.

TABLE 44

SUMMARY OF RESULTS FOR THE QUESTION-ANSWER AND LISTENING GROUPS IN PRINCIPLES OF ECONOMICS

	Question-answer Group		*Listening Group*			
Test Form	*N*	*Mean*	*N*	*Mean*	*t*	*p*
A	55	72.7	69	74.3	.78	>.05
B	55	69.1	71	70.7	.69	>.05

It may be concluded that opportunities to ask questions did not produce a significant difference in academic achievement compared with the procedure in which the exchanges between students and the instructor were heard and observed by students who themselves had no opportunity to ask questions.

Reactions of Students to Question-Answer Procedure and Its Use in Principles of Economics. Following an experiment with independent study as supplementary to TV instruction, (which will be reported later) the focus of interest again centered on giving students an adequate opportunity to evaluate the use of question-answer procedures with the "two-way" microphone in Principles of Economics. Those students who were not in rooms equipped with a two-way question-answer system for the first four weeks of the semester were moved to rooms thus equipped and vice versa. Then, the procedure of using the system as previously described was continued for two months. At the end of the semester, a survey was made of reactions to the question-answer system and its use.

Reproduced below is the form used and the tabulated results in terms of frequencies of responses to items:

We would like to know your reactions to having a microphone available in your TV classrooms in order to ask questions of your professor. Would you please, therefore, check the statements below which best reflect your opinion.

1. During the periods when a microphone was available, I:
   - 50 liked the idea very much
   - 56 liked the idea somewhat
   - 107 neither liked nor disliked the idea
   - 4 disliked the idea somewhat
   - 2 disliked the idea very much

2. I think having a microphone available in this TV course:
   - 1 significantly lowered my achievement in the course
   - 2 somewhat lowered my achievement in the course
   - 184 did not affect my achievement in the course
   - 30 somewhat improved my achievement in the course
   - 2 significantly improved my achievement in the course

3. With regard to *future* courses presented over TV, I think a microphone:
   - 79 definitely should be used
   - 68 probably should be used
   - 65 would make little difference
   - 7 probably should not be used
   - 2 definitely should not be used

4. Check the statement which indicates how often you, personally, used the microphone to ask a question (either directly or through a class assistant.)
   - 6 frequently
   - 2 sometimes
   - 5 once in awhile
   - 19 hardly ever
   - 189 never

The results may be summarized as follows: Students were about equally divided between liking (106) and being neutral (107) to the use of the question-answer system. Only six disliked the system. The majority (184) correctly estimated, as indicated by test scores, that the system did not affect

their achievement scores, while 32 students believed that it may have improved their scores. The majority of the students (147) recommended that a microphone should be used, others (65) refrained from making a positive or negative judgment, and nine students said it should not be used. The next reaction is most interesting: There was a strong positive reaction to the question-answer system in spite of low frequency of its use. Only eight students used the microphone frequently or sometimes, five used it once in a while, and 208 of those surveyed used it hardly ever or never.

Clearly the very small number of students who used the question-answer system and the limited extent of its use are factors which affect the results. Even those who did not use the system, approved of the arrangement. Apparently students want to have the opportunity of asking questions even though they may not do so.

Effect on Achievement of a Question-Answer Procedure in Air Science

The information reported above for Principles of Economics confirmed previous results of an experiment conducted in Air Science during the Fall Semester of 1955. One of the objectives of the Air Science experiment was to test the effect on achievement of a question-answer system and its use.[1]

Within the TV section, 120 students were randomized with 30 students being assigned to each of four TV classrooms. Two of the classrooms were equipped with two-way communication connected with the originating room. The other two classrooms were not so equipped. Students in these latter rooms could not ask questions but they heard those asked over the audio system and observed the instructor's responses over television.

A military field-type telephone system was used with a portable microphone in the two classrooms. Students raised their hands and had a microphone passed to them so that they could ask questions. The instructor wore earphones during question periods.

The use of the question-answer procedure covered a period of seven class sessions. Observations were made of the type and number of questions asked during six of these seven meetings of the section. Questions were essentially requests for clarification of information or concepts, for amplification of points and for repetition of information. There were eight question periods during the six sessions when records were made of questions asked. During these periods, 28 questions were asked by 26 different cadets.

An examination consisting of 60 objective-type questions and with a reliability coefficient of .74 as computed by the Kuder-Richardson formula 20, was given to all students and results were analyzed.

Table 45 gives the results of the experiment using an analysis of covariance with scores on the first two examinations as the adjusting variable.

1 For a more complete discussion of the question-answer system see Chapter 3, pp. 47-49.

TABLE 45

Summary of Results of a Question-Answer Procedure in Air Science

Source	*SS*	*df*	*V*	*F*	*p*
Treatments	23.33	1	23.33	.82	>.05
Error	3097.22	109	28.41		
Total	3120.55	110			

Treatment	*N*	*Adjusted Means*
Question-Answer Group	56	36.39
Listening Group	56	35.48

The use of what appeared to be a rather awkward two-way communication system in this experiment for a period of seven class sessions did not produce significant differences in measured achievement of air cadets. This effect is not surprising considering the limited use to which the system was put and considering that the control group heard the questions and answers over television even though its members could not ask questions.

The attitudes of cadets toward the use of the question-answer system as experienced in Air Science is summarized as follows: Cadets expressed a mildly favorable interest in the procedure. Only 15 percent of the students in two rooms without the two-way system expressed an interest in moving to the microphone-equipped rooms.

Effects of Independent Study Procedures

Effects on Achievement of Required Attendance at Problem-Solving Sessions vs. Required Independent Study in Principles of Economics

The 120 students constituting the upper 40 percent of students on the first examination in Principles of Economics during the Spring Semester 1957 were randomized into two groups. One group of 60 students was required to attend the discussion and problem-solving sessions (regularly a part of the course) which were scheduled for 50 minutes each week and led by graduate assistants. The principal instructor visited the classes on a rotating schedule. The second group of 60 students was required *not* to attend the discussion problem-solving sessions. These students were instructed to solve independently the same problems assigned to the other group. All students attended the two televised lectures each week. This arrangement was followed for four weeks. At the end of this time, all students were given an examination consisting of two sections, one of multiple-choice items and one of problems to be solved. Two forms of the examination were used; students in adjacent seats took different forms of the test.

Table 46 gives the results of both parts of the examination for each form of the test.

TABLE 46

SUMMARY OF RESULTS FOR REQUIRED ATTENDANCE AT PROBLEM-SOLVING SESSIONS VS. REQUIRED INDEPENDENT STUDY IN PRINCIPLES OF ECONOMICS

Test Form	*Question Type*	*Required Attendance (N = 60) Mean*	*Independent Study (N = 60) Mean*	*t*	*p*
A	Multiple-Choice	34.3	33.8	.35	>.05
	Problem-Solving	44.6	39.8	3.64	<.05
B	Multiple-Choice	27.8	29.0	.78	>.05
	Problem-Solving	45.1	41.0	2.72	<.05

Significant differences between those who attended the problem-solving sessions and those who did not were shown on the *problem-solving parts* of both forms of the test. Those who were required to attend the discussion problem-solving sessions made significantly higher scores. No differences were found between the two groups on the multiple-choice items of the two tests. Evidently work on problem-solving in those classes where there was an opportunity to discuss points and ask questions while solving the problems improved the students' scores on tests requiring problem-solving. It should be observed, however, that difference effects did not generalize from problem-solving to the multiple-choice test items which sampled the factual information and general principles taught in the televised lectures which both groups experienced.

Reactions of Students to the Use of Independent Problem-Solving Procedures in Principles of Economics. The 60 students who were required to solve economics problems outside the classroom for the four-week period, were asked to complete the following form and thus express their reactions and give supplementary information about the plan. Frequencies of responses are given for each question.

INSTRUCTIONS

This questionnaire is designed to obtain your reactions to working out Introductory Economics problems without being required to attend the weekly laboratory periods. Would you please, therefore, indicate your responses to the following statements. Since the questionnaire is anonymous, it would be appreciated if you would be frank in your responses.

1. Doing the problems on my own time outside of the weekly laboratory period:

   7 definitely did not reduce my ability to do them
   18 probably did not reduce my ability to do them
   11 may or may not have affected my ability to do them
   18 probably reduced my ability to do them
   5 definitely reduced my ability to do them

2. I found that working the problems out on my own time:

   7 was very difficult for me
   25 was somewhat difficult for me
   16 was neither difficult nor easy for me
   12 was relatively easy for me
   0 was very easy for me

3. With regard to doing problems on my own rather than being required to attend weekly laboratory periods, I:

   10 definitely like the idea
   14 like the idea somewhat
   9 don't care one way or the other
   18 dislike the idea somewhat
   9 definitely dislike the idea

4. For that period of time during which I did *not* attend the weekly laboratory periods, I did the following proportion of problems:

   45 did all
   5 did three-fourths
   2 did one-half
   5 did one-fourth
   5 did none

5. I did the problems:

   17 always by myself
   21 usually by myself
   14 sometimes independently and sometimes with others
   5 usually with others
   5 always with others

6. Additional comments:

   Twenty-nine students of the 60 wanted to attend discussion problem-solving sessions.

Effects on Achievement of Required Attendance vs. Independent Study in Elementary Meteorology

In the Spring Semester of 1957 independent study was compared with required class attendance for both direct and televised instruction in meteorology.

Additional students in meteorology who were not involved in the original experiment on direct versus televised instruction (not part of *core population*) were asked to volunteer for an experiment in independent study. In the TV section, 37 students volunteered and in the conventionally-taught section 47 students volunteered. Each of these groups constituted an experimental supply which was then randomized into two sub-groups. One sub-group had compulsory class attendance and the other had compulsory independent study for about four weeks. The latter group did not attend any of the lecture-demonstrations in this course during this period. All students were given a topical outline and a reading guide to follow. This phase of the study was carried out between the first and second examinations in the course.

Tables 47 and 48 show the results of analyses of covariance for both the TV and directly-taught groups, comparing the compulsory attendance with independent study sub-groups. Scores on the first examination were used as a matching variable. The maximum possible score on the examination was one hundred points.

TABLE 47

SUMMARY OF RESULTS FOR STUDENTS IN TV SECTION OF ELEMENTARY METEOROLOGY COMPARING COMPULSORY ATTENDANCE WITH INDEPENDENT STUDY

Source	*SS*	*df*	*V*	*F*	*p*
Treatments	126.90	1	126.90	1.36	>.05
Error	3176.42	34	93.42		
Total	3303.32	35			

Condition	*N*	*Adjusted Means*
Compulsory Attendance	19	58.48
Independent Study	18	54.77

TABLE 48

SUMMARY OF RESULTS FOR STUDENTS IN DIRECTLY-TAUGHT SECTION OF ELEMENTARY METEOROLOGY COMPARING COMPULSORY ATTENDANCE WITH INDEPENDENT STUDY

Source	*SS*	*df*	*V*	*F*	*p*
Treatments	12.82	1	12.82	.09	>.05
Error	6180.32	44	140.46		
Total	6193.14	45			

Condition	*N*	*Adjusted Means*
Compulsory Attendance	22	59.29
Independent Study	25	58.25

These analyses do not show significant differences between compulsory attendance and independent study groups either for the TV or directly-taught sections.

Effects on Achievement of Varied Use of Workbooks in TV Classes in General Psychology

Efforts to improve instruction over television may result in various ways for supplementing TV classroom work. The study of standard textbooks is strongly emphasized in college courses. Library references are also used, but generally for advanced rather than general introductory courses in large universities. As the enrollment at Penn State increases, it becomes progressively more difficult to provide sufficient library reference sources for large multiple-section and TV courses. Small discussion groups and tutorial sessions led by seniors and graduate assistants have been explored and will continue to be studied. The use of individual workbooks developed in conjunction with a textbook is a widespread practice which presumably has as its objectives providing problem-solving exercises, active reinforcement and repetition of the subject matter of the textbook.

During the spring of 1956 answers were sought to the question of whether or not the use of workbooks by students in psychology, under varied conditions, would contribute to their achievement in the course.

Two large TV sections which met at successive hours, were randomized into three groups for each section. Groups A, B, and C were assigned to different classrooms. All students were asked to buy the same textbook. All received the same instruction simultaneously presented over television and given by the same instructors. Group A of both sections was not given workbooks. Workbooks were supplied by the publisher and issued free to those students in Groups B and C of both sections.

The students in Group B were given the workbooks and instructed to complete the exercises outside of class. While the workbooks were not collected or checked in this group, the proctors periodically encouraged students to use them.

Group C students were given workbooks and held to a regular schedule of completion for each week's part of the course. The workbooks were collected from the students weekly, read and corrected by senior student assistants and returned to the students.

The workbooks were collected from all students at the end of the semester. The experiment was continued for about 8 weeks, from the first examination in the course. A

TABLE 49

SUMMARY OF RESULTS ON USE OF WORKBOOKS IN GENERAL PSYCHOLOGY (SECTION 1)

Source	*SS*	*df*	*V*	*F*	*p*
Treatments	107.42	2	53.71	1.48	>.05
Error	9815.34	271	36.22		
Total	9922.76	273			

Group	*N*	*Adjusted Means*
A No workbooks	151	41.25
B Workbooks not corrected	73	41.29
C Workbooks corrected weekly	51	42.88

TABLE 50

SUMMARY OF RESULTS ON USE OF WORKBOOKS IN GENERAL PSYCHOLOGY (SECTION 2)

Source	*SS*	*df*	*V*	*F*	*p*
Treatments	1.24	2	.62	.02	>.05
Error	8946.06	272	32.89		
Total	8947.31	274			

Group	*N*	*Adjusted Means*
A No workbooks	154	40.45
B Workbooks not corrected	68	40.56
C Workbooks corrected weekly	54	40.60

carefully prepared examination was then administered covering the course up to this date.

Tables 49 and 50 give the analyses of covariance using the scores of the first examination as the adjusting variable.

It is clear that comparisons of scores made on a general examination showed no important differences among the three conditions having to do with workbooks. Considering the amount of work done by the students, it did not seem reasonable to conclude that they learned nothing from the use of workbooks. Therefore, as part of the third examination, a special test of 20 items was prepared and given. Included were 10 general items written on topics covered in the text and lectures and related to workbook topics and 10 items based specifically on the workbook exercises.

TABLE 51

SUMMARY OF RESULTS FOR TEST BASED SPECIFICALLY ON WORKBOOK IN GENERAL PSYCHOLOGY (SECTION 1)

Source	*SS*	*df*	*V*	*F*	*p*
Treatments	65.56	2	32.78	20.98	<.05
Error	340.60	218	1.56		
Total	406.16	220			

Group	*N*	*Means*
A No workbooks	115	6.03
B. Workbooks not corrected	65	6.82
C. Workbooks corrected weekly	41	7.41

TABLE 52

SUMMARY OF RESULTS FOR TEST BASED SPECIFICALLY ON WORKBOOK IN GENERAL PSYCHOLOGY (SECTION 2)

Source	*SS*	*df*	*V*	*F*	*p*
Treatments	38.72	2	19.36	10.33	<.05
Error	427.21	228	1.87		
Total	465.94	230			

Group	*N*	*Means*
A No workbooks	130	6.25
B Workbooks not corrected	55	6.98
C Workbooks corrected weekly	46	7.17

Tables 51 and 52 give the results of analyses of variance for the three conditions in the two TV sections on the 10-item test based specifically on the workbook.

The 10-item test prepared specifically on workbook exercises yielded different scores which were significant for the means of all three conditions in Section 1. The group which had workbooks corrected weekly scored significantly higher than the group which completed the workbooks and delivered them at the end of the semester. In Section 2 there were significantly higher scores for both workbook groups compared with the no-workbook group. The difference between the two groups who had workbooks was not significant.

Analysis of the scores of the examination composed of 10 items not taken specifically from the workbook exercises yielded no significant differences among the three groups for either section of the course.

A reasonable interpretation would seem to be that the use of this workbook by students contributed added amounts of specific learning. However, this learning apparently did not generalize sufficiently to increase test scores on the general examinations in the course. It may be possible to develop kinds of workbooks which, when studied and completed by students, will increase the general achievement in the course.

Attitudes of Students toward the Use of Workbooks in General Psychology. The following information form was given to students in workbook groups at the end of the semester. The combined results from Section 1 and Section 2 are given in percentage scores for each item and category.

The majority of students favored using workbooks especially if they were given free copies as was done in this experiment. Those students who had their workbooks corrected were most favorable and this was their recommended procedure. A majority of students in both groups reported that they believed that use of workbooks helped them understand the

course. There remains the question of whether or not the small test score gains justify the use of workbooks.

STUDENT RESPONSES TO INFORMATION SCHEDULE
(Sections 1 and 2 Combined)

	Group B (Workbook not checked)	*Group C (Workbook checked weekly)*
"If I had a choice about using a workbook for this course I would . . ."		
a. buy it myself to use one	24.2%	42.7%
b. use it only if it were given to me	54.2%	41.7%
c. prefer not to use one at all	21.6%	15.6%
"If I had a workbook, I would prefer to . . ."		
a. have it corrected weekly to show me my mistakes	27.5%	59.4%
b. merely have it checked to get me to use it	7.5%	10.4%
c. use it as a study guide but not have to return it	55.8%	26.0%
d. not use it at all	9.2%	4.2%
"Using the workbook had this effect on my understanding of the material in Psychology 2 . . ."		
a. helped me very much	16.7%	27.1%
b. helped somewhat	58.3%	54.2%
c. had no effect	15.0%	16.6%
d. hindered somewhat	10.0%	2.1%

VISUALIZED VS. TRADITIONAL METHODS OF PRESENTATION OF SUBJECT MATTER

Effects on Achievement Scores of Variations in TV Presentations in Air Science

The problem of assessing the effectiveness of two patterns of presenting instruction over television was attacked in Air Science during the Fall Semester of 1956-1957. The comparison was made between the teaching of an instructor using a lecture-blackboard method and the teaching of a team of two instructors (including the single instructor) which employed lecturing supplemented by prepared charts, models, training films, discussion panels, visiting speakers, still pictures, and dramatizations. The intent here was to compare a traditional pattern of teaching, with a pattern which had been specifically adapted to television by the use of much more varied visual materials. It was expected that this latter method would improve the course and that the improvement would be reflected in examination scores of students.

The 829 Air Science students were randomly distributed into two TV sections; 269 cadets in Section 1 which met at 1:10 o'clock on Tuesdays and Thursdays and 560 cadets in Section 2 which met the following hour on the same days. Section 1 was taught by the single instructor who lectured and made appropriate use of the blackboard for outlining points and illustrating them. Section 2 was taught by the instructional team of two instructors who lectured and used an extensive variety of means of presenting information and stimulating interest.

In this experiment no text materials, lesson units, or study guides were used. Texts were not available for reference study. Thus the first block of instruction, Introduction to Elements of Aerial Warfare and Targets, was presented entirely over television in both sections. Attempts were made to present to both sections the same subjects, and comparability was checked by recording and studying tapes on the instruction given to both sections. These tapes were also used in constructing examinations.

A 40-item multiple choice test was prepared by the instructors and members of the TV Project staff, and administered to all cadets.

Table 53 gives the results with an analysis of covariance using a previous examination as the adjusting variable.

TABLE 53

SUMMARY OF RESULTS ON TWO PATTERNS OF INSTRUCTION IN AIR SCIENCE

Source	*SS*	*df*	*V*	*F*	*p*
Treatments	136.94	1	136.94	13.53	<.05
Error	7154.77	707	10.12		
Total	7291.71	708			

Treatment	*N*	*Adjusted Means*
Lecture and blackboard	247	21.52
Lecture and varied supplements	463	20.62

The difference favored the lecture-blackboard presentation by .90 points. The difference is significant and is in the reverse direction from the expected result. A replication of this experiment is planned for the future since the results are not in accord with findings on similar comparisons (e.g. General Psychology).

Two important points are raised for consideration by this study:

(1) Extensive adaptations of instruction with use of many teaching materials and methods may not improve students' scores on examinations.

FIGURE 3. THE PRESENTATION OF AN EXPERIMENT IN PROBLEM SOLVING FOR COURSE IN GENERAL PSYCHOLOGY

(2) It seems highly probable that students need to learn how to learn from new and different methods and materials. Hence, the methods and materials with which students have had most experience may be the best for them until such time as they have the opportunity of learning how to learn from new and unfamiliar teaching procedures.

Effects on Achievement of Variations in the Methods of Instruction in General Psychology

An experiment similar in principle to that conducted in Air Science was done in General Psychology during the first nine weeks of the Spring Semester of 1957. The problem was to compare a conventional lecture-blackboard TV presentation with adapted, visualized television instruction which included demonstrations, visualized concepts, close views of apparatus, actual presentation of testing situations and films. Both versions of the course presentation were televised and covered the same outline of course materials. Students did not have textbooks, and therefore emphasis was put on learning in class from the televised instruction.

Two TV sections each with about 300 students were scheduled at successive hours. Out of the total population of about 600 students, 191 could be randomized across the course sequences. Eighty-one were randomized into the first TV section and 110 into the second TV section. These subjects were the core experimental populations for whom analyses were made.

Both sections were taught by the same instructors. First the adapted version of the course was presented to the first section and during the next hour the conventional lecture-blackboard version of the course was presented to the second section.

A pre-test was given to all students in both sections and for the experimental subjects this test was used in the co-

variance analysis of their test scores. Tests were given on a three-weekly schedule.

The achievement scores are given with analyses in Tables 54 and 55.

TABLE 54

COVARIANCE ANALYSIS OF THREE TESTS OF ACHIEVEMENT WITH VARIED PRESENTATIONS IN GENERAL PSYCHOLOGY

Source	*SS*	*df*	*V*	*F*	*p*
First Test					
Treatments	6.33	1	6.33	.46	>.05
Error	2449.23	176	13.92		
Total	2455.57	177			
Second Test					
Treatments	.67	1	.67	.06	>.05
Error	2090.74	175	11.95		
Total	2091.41	176			
Third Test					
Treatments	17.86	1	17.86	1.07	>.05
Error	2826.48	170	16.63		
Total	2844.34	171			

TABLE 55

COMPARISON OF VARIED TV PRESENTATIONS OF INSTRUCTION IN GENERAL PSYCHOLOGY

	Adapted Version		*Conventional Version*	
	N	*Adjusted Means*	*N*	*Adjusted Means*
First Test	72	21.07	107	21.46
Second Test	72	25.59	106	25.62
Third Test	71	25.86	102	26.51

No significant differences were found in achievement test scores of students taught by television under the two conditions of adapted and conventional instruction. Some hypotheses for future testing, arising out of this failure to obtain differences between two widely differing methods of teaching the General Psychology and Air Science courses are discussed on pp. 64-65 in Chapter 3 of this report under the general heading of appropriateness.

Reaction of Students. Reactions of students who were taught by the two methods of instruction in the General Psychology course were studied by a behavioral choice method. This study is reported on pp. 78-80 in Chapter 4 of this report under the general heading of acceptability of televised instruction expressed by majority vote.

RELATIONSHIP BETWEEN METHOD OF INSTRUCTION AND CHARACTERISTICS OF THE STUDENTS

In evaluating psychological and educational research, interest is usually focused upon the significance of differences between means of groups. Means, of course, are indicative of the general levels of performance. Although experimental conditions can influence the variability of performances, as well as their general level, attention is less often directed to the differences among group variances.

This lack of attention to differences in variability is all the more difficult to understand in view of the fact that a test of significance of such differences is often performed as a check on the assumption that treatment effects are constant and additive. That is to say, the *t* or *F* test of significance of differences between means assumes that the effect of any treatment is the same for all subjects on whom the treatment is imposed. Group variances are usually compared in a test of "homogeneity." A finding of heterogeneity indicates that the effects of treatment vary from one individual to another, a result of considerable interest to the investigator in its own right.

The possibility that the magnitude of treatment effects depends on the ability, interest, or attitude of the subject is a reasonable one and the investigator should be alert for it. In the Penn State TV Project, group variances have been regularly compared. In only one instance was a significant result obtained. This significant result was found in the Air Science course when the two group variances on the examination given in the Fall Semester of 1956 were compared. The variability of the group receiving the traditional presentation was less than that of the group receiving the visualized presentation. This particular difference in variability was quite obviously due to the restrictive ceiling on the test. Students in the traditional group did better on the average and their scores clustered together near the top of the scale. No other instances of differences among group variances have been found and there is, therefore, at present no evidence that the effect of experimental treatments in the television research relates to characteristics of the student subjects.

EFFECTS OF TELEVISED INSTRUCTION ON STUDENTS' COURSE-RELATED ATTITUDES

Introductory Statement

General educational objectives and those of specific courses are frequently so phrased as to imply that, as a result of instruction, changes in attitudes are expected to occur. Education might reasonably be assumed to affect the belief and value systems of students. For example, as a result of college training students should become more tolerant and less prejudiced. Information gained in courses should form the basis for sounder and more objective judgments about personal and social problems. Students who are being "educated" in the highest sense are expected to broaden their perspectives on cultural norms and have a better understanding of the differences which exist between their own and other cultures. Students being educated in a democratic

society should demonstrate course-related increases in their understanding of the social processes, and hence should become less authoritarian. Finally, courses related to vocational and professional fields usually have as objectives (either implicit or explicit) increasing the student's interest in his occupational field and changing his attitude toward it in an increasingly favorable direction.

A great issue of modern education is that of how the value systems and attitudes of students can be changed in desirable and approved directions. Whether formal educational methods and procedures can significantly affect the values and attitudes of students is a question of prime importance. This issue is particularly acute for students of college age and for the institutions responsible for their education.

Studies of educational processes and their impact in favorably changing beliefs, prejudices, value systems and attitudes, have indicated that such personality factors show resistance to change. Such hoped-for changes are sometimes referred to as the "intangible" effects of instruction implying that these factors cannot be measured or even assessed. Nevertheless, such effects are considered to be vitally important. Gradually it is being shown that television can be used as effectively as other procedures for teaching factual information and concepts. The critical question is often raised of whether televised instruction can produce changes in the attitudes of students. Therefore, it is necessary to compare the relative effectiveness of televised and direct instruction on the change in attitudes of students since this is an important educational function and responsibility.

Research of the Penn State TV Project has collected limited information thus far on the relative effects of televised and direct instruction on course-related attitudes of students. Studies conducted using the Authoritarian Personality Scale in General Psychology were described in Report Number One.[1] It is the purpose of this section to review more recent findings in this area.

Effect of Direct and Televised Instruction on Students' Attitudes in Introductory Sociology

In Introductory Sociology given in the spring of 1956 an effort was made to assess the relative influences of televised and direct instruction on students' attitudes toward people and social issues. The Inventory of Beliefs was used as the measuring instrument. The test was administered at the beginning and re-administered at the end of the course.

Table 56 presents the data and analysis of covariance using pre-test scores as the adjusting variable.

Analysis of covariance of the Inventory of Beliefs scores indicates no significant differences between the directly and TV taught groups at the end of the semester. On the basis of the foregoing results it must be concluded that the direct and TV presentations of Introductory Sociology had comparable effects on attitudes of students as measured by the Inventory of Beliefs.

TABLE 56

SUMMARY OF RESULTS ON INVENTORY OF BELIEFS IN INTRODUCTORY SOCIOLOGY

Source	SS	*df*	*V*	*F*	*p*
Treatments	3.24	1	3.24	.03	>.05
Error	19706.93	211	93.40		
Total	19710.17	212			

Treatment	*N*	*Adjusted Means*
Direct Instruction	111	71.04
TV Instruction	103	70.81

This experiment also dealt with the question of the relation between achievement gains and changes in scores on the Inventory of Beliefs. This effort was based on the assumption that students' achievement in the course may be correlated with changes of opinions, attitudes and beliefs. A Pearson product-moment correlation on 215 cases yielded a correlation of .02 which was not significant. A correlation coefficient was also computed between students' achievement scores for the course and their scores on the final administration of the Inventory of Beliefs. This correlation coefficient of .43 was significant at the .01 level, and indicates that the better achievers in this Sociology course were also less authoritarian than the poorer achievers.

Effects of Televised Instruction in Air Science on Students' Attitudes toward Careers in the Air Force

A central concern of those officers who administer and teach Air Force ROTC courses is that of recruitment of qualified officer personnel. Prior to and during the early phases of the use of television, those responsible expressed fear that this use of television might reduce the number of cadets electing advanced courses in the Air Force curriculum. After several semesters of experience with televised instruction this concern has greatly reduced. The number of students applying for officer training in advanced courses has steadily increased along with the use of television. However, this increase certainly cannot be solely attributed to televised instruction. Simultaneously, instruction has been changed and possibly improved, flying experience has been provided for cadets in Air Science courses, and generally the "tone" of Air Force ROTC has been improved. Nevertheless, the increased numbers of cadets electing advanced work have reassured responsible officers that extensive use of closed-circuit television is acceptable and does not affect adversely the attitudes of students toward careers in the Air Force.

An attempt was made to assess changes in attitudes as a result of the unit of instruction, Careers in USAF, given for

[1] C. R. Carpenter, L. P. Greenhill et al., Report No. 1, An Investigation of Closed-Circuit Television for Teaching University Courses. The Pennsylvania State University, July 1955.

three weeks during the spring of 1957. The unit of instruction was presented completely over television using a variety of procedures. These included an address by the Professor of Air Science, guest lecturers, talks by specialists, films, graphic reports of summer training, panel discussions, picture coverage of flying activities, descriptions of career development plans and reports on social statuses of Air Force personnel.

A short questionnaire was administered during the first period of the unit and re-administered during the last period. The results showed a slight shift from "not interested" to "will think it over" as a response to the item designed to sample interest in the advanced Air Force curriculum. There was no indicated change of interest in flying. There was no change in the interest expressed in an Air Force career. Intention to take the Air Force Officer Qualification Test increased 100% from the pre-unit to the post-unit questionnaire. Very few who said they wished to take the test on the final questionnaire failed to do so.

Cadet interviews disclosed that among those meeting the Selection Boards for Advanced AFROTC, 53 percent had made their decision to apply after coming to Penn State. Of this percentage 14 percent referred specifically to the Air Science "Careers" block of instruction as having influenced their decision.

All instruction was given over television; there were no comparison groups.

Concluding Remarks on Effects of TV Instruction on Students' Attitude Changes

Research on educational processes related to the structuring of attitudes and values is in a stage of development largely characterized by the formulation of theories and the statement of assumptions and hypotheses. Some advance is being made toward the construction of adequate and appropriate measuring instruments. It seems very reasonable to assume, and such assumptions are supported by general observations and by some measurements, that college students do change their attitudes as they study their college courses. The challenging task of defining the specific functions of the educational processes which effect desired changes in attitudinal behavior remains to be done. This general and fundamental problem must be attacked on a broad front which would include a study of the relative effectiveness of televised instruction on many kinds of attitudes, values, and judgments. Meanwhile, there is not sufficient evidence to show that televising college courses results in any more significant changes in students' attitudes than other accepted methods of presenting college instruction.

3—Studies of Appropriateness

Introductory Statement

Explorations at Penn State under the general heading of appropriateness of television for university teaching have proceeded along several lines:

1. A wide range of courses in different curricula has been sampled.
2. A major effort has been made to adapt courses to television in order to take advantage of the potentials of television for the presentation of a variety of instructional materials.
3. A number of different ways of using television have been tried in accordance with the needs of courses, the availability of classrooms of different types and sizes, and the requirements of experimental designs.
4. An attempt has been made to gather information about the adaptations of buildings for the installation and effective utilization of television.
5. The selection and adaptation of different kinds of television systems and the development of new equipment needed in instruction have continued concurrently with other phases of the program.

Policies Adopted to Select Courses for Presentation on Television

One of the primary requirements of the TV Project at Penn State has been to explore as wide a range of courses as possible in order to determine whether television is an appropriate medium for their presentation, or to find what changes need to be made either in the course or the method of employing television to secure effective instruction.

One possible approach to the sampling of courses would have been to select systematically a number of courses for study and then with some strong administrative pressure encourage faculty participation. The organizers of the TV Project at Penn State followed a different course. Television was originally introduced at the departmental level as a cooperative project between the Chemistry and Psychology Departments. As the Project became better known, instructors in other departments who expressed interest in teaching their courses over television were encouraged to do so. As a consequence there has been a steady growth of faculty interest, and an increasing range of courses offered on television. The University's administration, while keenly interested, has kept somewhat in the background.

The scheduling of courses for television has now become primarily the responsibility of the University's scheduling officer, who works in conjunction with department heads and administrative personnel of the TV Project. In considering a new course for presentation on television several criteria were applied:

(1) There should be a clear need for television in terms of numbers of students to be served either now or in the near future, or in terms of shortages of competent faculty members either now or in the foreseeable future.

(2) There should be some possibility of improving the quality of the instruction.

(3) The instructor who will teach the course should be a thoroughly competent teacher, and one who is personally interested in experimenting with his course on television.

(4) It should be feasible to schedule the course on television.

In order to justify the use of the University's most complex television system (a dual "professional" vidicon camera chain linked to 19 classrooms) it was decided that a course should ordinarily have *a minimum* of about 200 students enrolled and available or potentially available. Exceptions were sometimes made in the case of courses which were being explored for the first time. However, even here the possibility should exist of eventually serving large numbers of students if the initial trial should prove to be successful.

Other applications of television require relatively simple systems which range from a single camera with one or two receivers (as in metallurgy or speech) to a single camera feeding four to six receivers (as in engineering or chemistry). Under these circumstances it is believed that relatively small numbers of students can be served and still justify the investment of $2,000 to $3,500 in the television equipment.

Courses Sampled

A steady growth in the courses sampled is evident over the five semesters during which television has been used.

Spring 1955. During the first semester's operation three courses were presented on television: General Chemistry, General Psychology, and Psychology of Marriage.

Fall 1955. Nine courses were taught using closed-circuit television during the fall of 1955. These included: Air Science (ROTC), General Chemistry (two sections), Elementary Business Law, General Psychology (two sections), Psychology of Marriage, Principles of Economics, Music Appreciation, Introduction to Education, and Speech.

Twenty-four instructors and 2,400 students were involved in these courses.

Spring 1956. In the spring of 1956 the number of courses which used television increased to twelve. These comprised: General Psychology (two sections), Elementary Accounting, Principles of Economics, Speech, Elementary Business Law, Introductory Political Science, Introductory Sociology, Music Appreciation, Air Science (ROTC), Introduction to Education, General Chemistry (two sections), and Introductory Electrical Engineering. Some 3,300 students were enrolled in these courses, and there were 38 hours of televised classes each week.

Fall 1956. Thirteen courses used the closed-circuit television systems in the fall of 1956. A language course, Elementary German, was added. Psychology of Marriage, which had not used television for a semester because of a schedule conflict, was included again. The number of sections of General Chemistry greatly increased as a result of a change in the curriculum requirements for engineers.

The courses using television included: General Psychology (two sections), Introductory Sociology, Music Appreciation, Introduction to Education, Psychology of Marriage, Introductory Political Science, Elementary Business Law, Elementary German, Principles of Economics, Elementary Accounting, Air Science (ROTC), General Chemistry, and Introductory Electrical Engineering. There were about 48 hours per week of televised classes during the Fall Semester of 1956, with an enrollment of approximately 4,700 students.

Spring 1957. The television schedule for the Spring Semester of 1957 including eighteen courses. Elementary Meteorology, Intermediate French, Advanced French, General Chemistry for Engineering Students, Introductory Engineering, Introductory Electrical Engineering, Audio-Visual Aids, and Introductory Industrial Engineering were new courses added to the schedule. In addition, television was used regularly in the laboratory parts of courses in Speech and Metallurgy. Production courses (Principles of Television Speech, Advanced Radio Drama, and Radio and Television in Education) designed to train students for work in educational broadcast and closed-circuit television operations made regular weekly use of the television systems. Elementary Business Law, Introductory Political Science, and Introductory Electrical Engineering did not use television during this semester.

About 4,200 students were enrolled in these courses. The small reduction in total numbers of students involved as compared to the Fall Semester is principally the result of the method of teaching engineers in the chemistry curriculum during their second semester. The largest single television section was in Air Science. In this ROTC course for sophomores all of the 810 students enrolled were taught simultaneously over television. This course made full use of the main system and 19 classrooms equipped with receivers.

The schedule of television courses for the Spring Semester 1957 is shown in Table 57.

The courses offered on television have been principally introductory courses where enrollment pressures are high. The professional training courses and the laboratory courses in Speech and Metallurgy were the only advanced courses which used television in the spring of 1956. In the introductory courses offered on television an effort was made to have highly competent instructors present good instruction to large numbers of students. In general, when a course was judged to be successfully taught on television, an attempt was made to retain it on the schedule in order to consolidate gains and make improvements in presentation, rather than to drop it for a new course. In a number of courses enrollments increased to the point where it was necessary either to use television or increase the number of faculty members for teaching these courses.

It has already been suggested that the question of the appropriateness of television involves not only the characteristics of the course to be taught and its requirements, but also considerations of how and to what extent the course can be modified. Similarly the possibilities must be considered of how television can be employed, what adaptations can be made and what non-TV supplementary teaching-learning procedures need to be employed to accomplish course objectives. Therefore, the following sections will describe some of the patterns of using closed-circuit television at Penn State. It is realized that the full range of adaptive possibilities have not been fully explored.

Patterns of Use of Television at Penn State

Under the general heading of appropriateness, Penn State has been exploring a number of different ways of using television in terms of the needs of the courses, the interest of instructors, the availability of classrooms of different sizes and types, and the requirements of controlled experimentation. The varied patterns of TV presentation may be summarized briefly as follows:

(1) Some courses in their entirety were televised to a number of separate rooms (Examples: General Psychology, Introductory Sociology, Music Appreciation, Elementary Meteorology, and Air Science). This pattern might be thought of as the instructor-multiplier function of television in which a competent professor teaches a number of classes simultaneously. This arrangement usually requires the use of a "professional" dual-camera television system.

(2) The lecture-demonstration parts of certain courses were televised. These presentations were supplemented by discussion, problem-solving, recitation and laboratory sessions. Under this arrangement the instruction originated in one room and was televised to a number of other rooms as in Pattern 1 above. In some courses there was one televised presentation a week by a senior professor followed by two recitation sections; in other courses there were two televised lecture-demonstrations supplemented by one recitation period a week (Examples: Elementary Accounting, Elementary German, Principles of Economics, Introductory Industrial Engineering, and Introductory Political Science). A two-way communication system was used in most of the courses listed above. It enabled students to ask questions and provided a means for instructors to encourage class participation

TABLE 57

Schedule of Television Courses, Spring 1957

SPARKS BUILDING

Hour	*Monday*	*Tuesday*	*Wednesday*	*Thursday*	*Friday*	*Saturday*
8	Psy. 2 (Sect. 1) Rms. 1, 2, 10, 18, 19, (20)		Music 5 Rms. 2, 12, 19, (20)	I.E. 131 Rms. 2, 18, 19, (20)	Psy. 2 (Sect. 1) Rms. 1, 2, 10, 18, 19, (20)	
9	Psy. 2 (Sect. 2) Rms. 1, 2, 10, 12, 18, 19, (20)	Econ. 2 Rms. 1, 2, 10, 11, 12, 18, 19, (20)		Econ. 2 Rms. 1, 2, 10, 11, 12, 18, 19, (20)	Psy. 2 (Sect. 2) Rms. 1, 2, 10, 12, 18, 19, (20)	
10	Soc. 1 Rms. 1, 2, 10, 11, 12, 13, 15, 18, 19, (20)	Ed. 1 Rm. (10) Meteo. 300–Rms. 1, 2, 11, 19, (20)	Acctg. 1 Rms. 1, 2, 11, 12, 18, 19, (20)	Ed. 1 Rm. (10) Meteo. 300–Rms. 1, 2, 11, 19, (20)	Soc. 1 Rms. 1, 2, 10, 11, 12, 13, 15, 18, 19, (20)	
11	Speech 437 Rms. 19, (20)	Ed. 1 Rms. 1, 2, 11, 19, (20)	Psy. 17 Rms. 1, 2, 11, 12, 19, (20)	Ed. 1 Rms. 1, 2, 11, 19, (20)	Speech 437 Rms. 19, (20)	
1:10	Music 5 Rms. 2, 12, 19, (20)	Air Science 4 All 18 TV rooms (20)	Psy. 2 (Sect. 1) Rms. 1, 2, 10, 18, 19, (20)	Air Science 4 All 18 TV rooms (20)	Music 5 Rms. 2, 12, 19, (20)	
2:10		French 30, 302 Rms. 2, 19, (20)	Psy. 2 (Sect. 2) Rms. 1, 2, 10, 12, 18, 19, (20)	French 30, 302 Rms. 2, 19, (20)	Ed. 424 Rm. (10)	
3:10	Acctg. 1 Rms. 1, 2, 11, 12, 18, 19, (20)	Speech 437 Rms. 19, (20)	Soc. 1 Rms. 1, 2, 10, 11, 12, 13, 15, 18, 19, (20)	Drama 481 Rms. 2, 10, 19, (20)	Acctg. 1 Rms. 1, 2, 11, 12, 18, 19, (20)	
4:10	Ger. 1 Rms. 1, 2, 11, 18, 19, (20)	Ed. 1 Rms. 1, 2, 10, 11, 12, 18, 19, (20)		Drama 481 Rms. 2, 10, 19, (20)	Psy. 17 Rms. 1, 2, 11, 12, 19, (20)	

OTHER BUILDINGS

Chemistry 2 .....119 Osmond–Tuesday and Thursday–9 and 10
5 .....119 Osmond–Monday–10 and 11
Engineering 1 .....110 E. E. –Friday–10
Electrical Engineering 9 .....110 E. E. –Tuesday and Thursday–8
Television is used on occasion in laboratory sections of Metallurgy and Speech 200.

( ) Indicates originating room

(3) Television was also used with large classes in large lecture halls to project and magnify instructional materials. The instructors and students met in the same large lecture hall and the students could view demonstrations and visual materials either directly or on television receivers located around the sides of the room. A single rather simple type of television camera was used in this situation (Examples: Introduction to Education, General Chemistry, Introductory Engineering, Introductory Electrical Engineering, and Metallurgy).

(4) Television was used for observing remote events. Television appeared to be particularly appropriate for teacher education, where it was desirable for student teachers to be able to observe teaching demonstrations, without intruding on the actual teaching situations. Such remote observation also permitted simultaneous discussion and anaylsis of the teaching process. Ordinarily, a simple television camera and audio system was satisfactory. Such a system was used in the Penn State Speech Department under the auspices of the TV Project. Also the regular televised courses were syste-

matically observed to some extent by student teachers from the Colleges of Education and Home Economics at Penn State. The systems were also used to provide teachers with demonstrations of the various techniques of teaching reading.

(5) Television was used for professional training in the field of television. There is an increasing demand for trained personnel to work in the operations of closed-circuit television in schools and colleges and in broadcast television. In addition, teachers are becoming aware of the possibility that they might be required to teach over television. In order to meet these demands, Penn State offered several training courses in this area (Examples: Principles of Television Speech, Advanced Radio Drama, and Radio and Television in Education).

Table 58 lists scheduled courses for spring 1957.

TABLE 58

List of Courses for Spring 1957 Showing Extent to Which Television Was Used in Each

Course	*Lecture-Demonstrations Per Week on TV*	*Recitations Per Week (No TV)*	*Laboratories etc., Per Week (No TV)*
Originated in One Room and Televised to Others			
Psychology 2	3	0	0
Sociology 1	3	0	0
Music 5	3	0	0
Meteorology 300	3	0	1 (Laboratory)
Air Science 4	2	0	0
Accounting 1	3	1	0
Economics 2	2	1	0
Education 1	2	0	1 (Large Group Common Hour)
Psychology 17	2	0	1 (Large Group Common Hour)
German 1	1	2	0
French 30	1	3	0
French 302	1	3	0
Industrial Engineering 131	1	0	0
Education 424	1	1	0
TV Used in Large Lecture Hall			
Chemistry 2	2	1	2 (Laboratory)
Chemistry 5	1	1	1 (Laboratory)
Electrical Engineering 9	2	1	0
Engineering 1	1	0	1 (Laboratory)
Television Used in Laboratory			
Metallurgy	TV Used in Laboratory		
Speech 200	TV Used to Observe Student Speakers and Teaching Demonstrations		
Drama 481, Speech 437, Education 487c	Television used in laboratory sections for professional training		

Adaptations of Courses to Television

A requirement of the first semester's research at Penn State in the spring of 1955 was that courses offered on television should be taught as nearly as possible in the same manner as they had been taught prior to the introduction of television. This requirement had several implications: If the usual procedure had been for an instructor to teach about 40 to 50 students in a group, then when the course was put on television a group of this size was scheduled in the originating room. This procedure was followed in General Psychology. If an instructor was accustomed to teaching a face-to-face group of about 150, then a group of this size was scheduled in the originating room when the course was televised. In General Chemistry two television cameras were located in fixed positions in the third or fourth row of the class. During this first semester the opinion was frequently expressed that better television coverage would be obtained if the course to be televised could be originated from a smaller classroom with few or no students present to interfere with the operations of the cameras. It was also decided that the instruction in the psychology courses would be improved if the professors would use more visual materials including actual demonstrations. Furthermore, during the first semester a number of students in the television rooms complained that they felt ignored because their instructor directed his attention to the students in his presence but rarely paid attention to the television cameras and hence to the remote classes. On the other hand, at this stage of their experience, the instructors felt that they needed a "live audience" in order to judge the immediate responses of students, and to regulate the speed of presentation.

Another factor which operated against rapid adaptation of courses to television was that it was not easy for most professors to change a method of teaching that they had practiced and perfected over a period of years. Nevertheless it was decided during the Fall Semester of 1955 that emphasis would be put on the matter of adapting courses to television. This was done in order to take advantage of the obvious potential of television for presenting a variety of visual teaching materials and situations. It was also decided that an effort would be made to vary the ways of using television in courses in order to provide opportunities for discussion, question-answer interactions and supervised recitation. Variations were also made in the originating room conditions in order to discover how television might be most appropriately and effectively used. These various adaptations will be described and evaluated in the following sections.

Use of Large Classroom as the Originating Room

As has been indicated previously, the classes in General Psychology, Psychology of Marriage, and General Chemistry originated on television during the first semester of operations from a large classroom with a number of students present in each instance.

Teachers seemed quite comfortable with this arrangement. However, it presented several disadvantages:

(1) Teachers tended to teach the class before them and to ignore the cameras, thus ignoring the groups of students who were receiving instruction over television.

(2) The fixed location of the cameras limited the flexibility of their use and restricted the kinds of materials that could be televised.

(3) It was considered uneconomical use of a large auditorium to employ it as an originating room with comparatively few students present.

Consequently, during the summer of 1955 a small classroom with floor dimensions, 20′ x 27′, located in Sparks Building, was taken over and equipped with lights, audio and camera outlets for use as an originating room.

The use of a large originating room was continued in instances where a professor had a strong preference for a large audience in front of him, where an experiment involved a free choice by the students, or where rotation of groups of students through the originating room had been arranged. This was the case with General Chemistry and Elementary Business Law during the fall of 1955. Introductory Sociology, Elementary Business Law, and Introduction to Education originated in this way during the spring of 1956.

All other TV courses were taught from the small originating room, with the auditorium used, where necessary, as a receiving room.

Use of Small Originating Rooms

During the Fall Semester of 1955 seven courses originated in the small classroom which had been equipped for television. The teachers of most of these courses still desired to have some students present in the originating room in order to obtain student reactions and to help pace the presentations. It was also hoped that these students would represent those watching in the television receiving rooms by asking questions which might be expected from all students and thus help all of the students feel closer to their instructor.

In the small originating room the amount of space that could be devoted to chairs for students was limited but for most courses from 10 to 20 students could be accommodated. By this time most teachers were aware of the necessity of dividing their attention between the cameras and the students in their presence. Several instructors worked out fairly satisfactory arrangements whereby they taught directly to the cameras when they personally were on camera, and gave their attention to students when a visual aid or blackboard material was being televised. A 24″ monitor was provided in the originating room to benefit the instructor and to enable students present to see some of the small visuals that were used under the new arrangement.

This arrangement, while apparently better than the use of the large auditorium for origination, still had some disadvantages:

(1) A large proportion of the space was occupied by students which restricted movement of the mounted and mobile cameras.

(2) Students in the originating room in most courses were very timid about asking questions, and even when they did so it was difficult to pick up and amplify their voices.

(3) The attitude persisted on the part of some students that those seated in the originating room were privileged, even though test results showed no advantage.

An attempt was made to overcome the students' timidity in asking questions by trying various methods for the selection of students to be in the originating room. The method of selection used in the course, Psychology of Marriage, apparently worked satisfactorily with a good deal of student participation. It consisted of selecting those students who were married or formally engaged. These students asked good questions and were not unduly inhibited. They contributed both to the content and method of teaching the course.

In other courses students for the originating room were first selected randomly. These students generally asked few questions. Later, students were invited to volunteer. In some instances this arrangement provided students who asked questions, but usually one or two students asked most of the questions, or even monopolized time. This procedure was not very acceptable to the viewing groups or to the critical teacher.

Apparently, if students are to be in the originating room, these individuals must be carefully selected and perhaps trained and encouraged to ask questions. The development of methods to select such students is a problem yet to be solved.

Use of the Originating Room without Students

The instructor in the Music Appreciation course decided that he would like to present his course on television during the fall of 1955, and he further decided to do so without having students in the originating room. Emphasis was to be placed on addressing the cameras directly and through them the students in the TV receiving rooms. He believed that in this way he could obtain maximum flexibility of presentation of a variety of materials and would avoid any conflict between teaching students who were present while still giving adequate attention through the cameras to the larger numbers dispersed in the TV classrooms. He appeared to be successful in doing this.

In the course, Principles of Economics, the instructor used both procedures but in different parts of the semester. For the first half of the semester he originated his instruction with about 20 students seated in the originating room. Later he taught directly to the cameras without students.

At the end of the semester a questionnaire was completed by the 315 viewers, in which they indicated their reaction to the presence of other students in the originating room. The results were as follows:

Preference	*Frequency*
No difference	218
Better to have students in the originating room	62
Better to have no students	35

This instructor developed the technique of teaching directly to the cameras when he was personally being televised and directing his attention to the students in his presence when visual materials were being televised.

The Air Science course during its first semester on TV also was presented from the small originating room without students present.

Gradually teachers in other courses tried out this procedure, and more and more of them have chosen to teach directly to the TV cameras from the small originating room without having students present in that room.

Rotation of Students Through the Originating Room

As was mentioned in the previous Section, Chapter 2, p. 25, the instructor who taught Elementary Business Law on television preferred to have a large group of students (about 100) in a large originating room. In addition, he required that all of the students in the course spend a part of the semester in this room. Therefore, a rotational system was worked out whereby every two weeks approximately 40 students would move from a TV receiving room to the originating room and 40 would move in the opposite direction.

During the Spring Semester of 1956, after eight weeks of this rotation, students were asked whether they would prefer to remain in the lecture-originating room, or would like to stay in one of the TV receiving rooms.

The students' preferences were as follows:

Preference	*Percentage*
Originating room	54%
TV room	42%
No preference	4%

Patterns of Instruction to Provide for Discussion in TV Classes

One of the most frequently voiced objections to televised teaching is that when instruction is originated in one room and sent by television to students located in a number of remote receiving classrooms, there is little or no opportunity for students to have discussion or to ask questions and have them answered immediately.

Some teachers do not see this lack of discussion as a problem. They point out that much time is often wasted by informal discussion and that many of the questions asked are irrelevant. They express the opinion that few questions are asked anyway, that teachers are always available during their "office hours" to help those students who really need it, and finally that when a student is observing a television lecture-demonstration he is not necessarily passive. He may not be reacting overtly by discussing, but he certainly could be reacting covertly, critically analyzing what he is being taught and relating it to what he has learned previously. Instructors holding this viewpoint contend that students come to depend too much on their teachers for ready answers to their problems. Television on the other hand, they argue, may force a student to study more on his own initiative and thereby develop a desirable degree of independence and self-reliance.

It would appear that there are undoubtedly many courses in which supervised practice or problem solving sessions are necessary, e.g., accounting and chemistry, and that there are other situations in which follow-up discussions are desirable to reinforce what has been presented in lecture-demonstrations. Other situations may be handled satisfactorily by the use of a question-answer communication system between the origination room and TV receiving rooms.

All of these possibilities as well as others were worth investigating to see what adaptations in teaching methods and techniques could be made in order to answer criticisms and to explore additional possibilities using television more oppropriately. Appropriateness would depend both on relative effectiveness of the different procedures and on their relative acceptability to students and teachers. In the following sections the various procedures tried out at Penn State for dealing with discussion and questions will be described and evaluated. Some aspects of the following experiments were described in Chapter 2 under the heading of Comparative Effectiveness. However, additional material relative to appropriateness will be given here.

Schedule of 35-Minute Lecture-Demonstration and 15-Minute Discussion Period Given Three Times Weekly

One way of providing for discussion is to set up a schedule in which each fifty-minute period is divided into two parts: (1) a 35-minute lecture-demonstration, followed immediately by (2) a 15-minute discussion period in which students in the TV classrooms meet as individual groups under the leadership of a senior or graduate assistants.

Such a procedure was explored in two courses, General Psychology and Principles of Economics, during the fall of 1955.

General Psychology. The procedure adopted in General Psychology was as follows: The principal instructor gave a 35-minute lecture-demonstration over television. He also

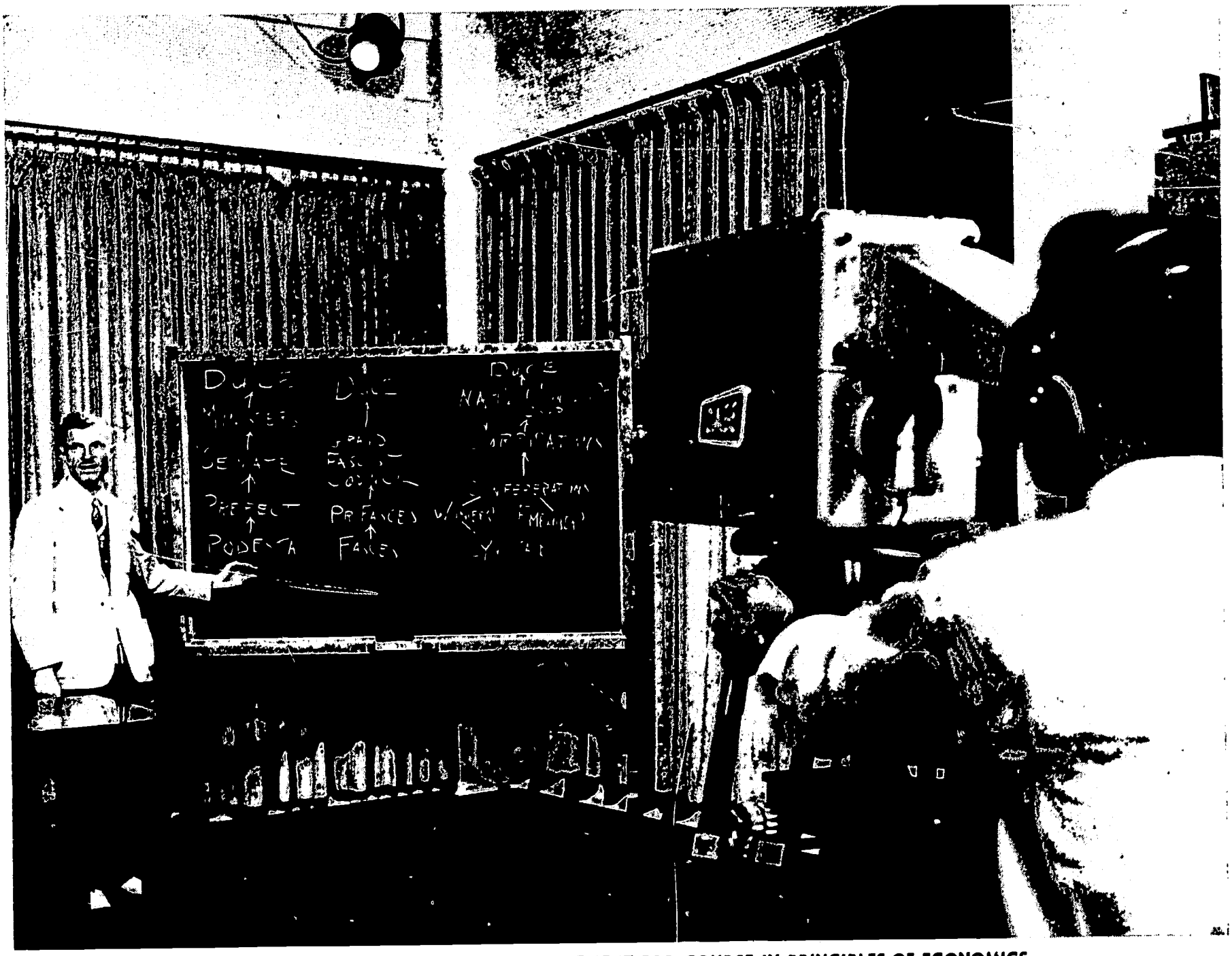


FIGURE 4. ORIGINATING ROOM ARRANGEMENT FOR COURSE IN PRINCIPLES OF ECONOMICS

prepared some material (a typical "case" for some relevant questions) for the 15-minute discussion session which followed immediately. Graduate assistants led the discussion groups under the direction of the principal instructor.

Three conditions were compared: Condition A provided for a 15-minute "live discussion" led by graduate students. Condition B required students to observe by television a discussion conducted by the principal instructor with a group of eight students in the originating room ("vicarious discussion"). Condition C provided no discussion. Students under this condition were permitted to study their notes or textbook or to leave the class.

These treatments were employed in two different sections of the psychology course. They were evaluated by making comparisons of academic achievement, general enjoyment of the course, and attitude toward the discussion arrangement actually experienced.

The results of this study are given in detail in Chapter 2, pp. 27-29 of this report. In brief, it may be said here that there were no significant differences in achievement for the students placed in any of the three different groups. Furthermore, it was clear from the results that those who were given an opportunity for *live discussion* were much more favorably inclined toward the use of a 35-minute lecture-demonstration–15-minute discussion arrangement than were those who merely "listened in" or who were permitted to leave the class.

Principles of Economics. In economics two different arrangements were compared in a non-experimental manner. For the first half of the semester a senior professor presented three times weekly a 35-minute lecture over television followed immediately by a 15-minute laboratory period. The laboratory periods were supervised by graduate assistants who worked closely with the professor. Students solved problem assignments during these periods and raised questions for discussion. The senior professor visited each laboratory section in turn. During the second half of the semester,

the professor presented two 50-minute lectures per week over television followed by a third 50-minute period devoted entirely to laboratory work as described above.

At the end of the semester students were asked which method of course presentation they preferred. Of a total of 155 students 71 percent expressed preference for instruction in two 50-minute lectures and one 50-minute laboratory period a week. Only 29 percent preferred the arrangement of the 35-minute lecture and 15-minute laboratory period. Students indicated that the concetrated 50-minute weekly laboratory period gave them a better opportunity to work out assigned problems or develop discussion to a fruitful stage than the three 15-minute periods each week.

Recitation and Discussion Patterns

In several other courses offered over closed-circuit television (Elementary Accounting, Introductory Political Science, and General Chemistry) it had been the previous practice to give two lectures per week followed by a 50-minute discussion or recitation period (in Elementary Accounting three lectures per week plus one recitation). Those responsible for these courses judged that this procedure was desirable, so it was continued when the courses were taught over television. In general, the use of television in these courses has made it possible to increase substantially the numbers of students taught at a given time in the lecture or lecture-demonstration parts of the course. The recitation periods are usually supervised by graduate assistants (chemistry has most recitation sections taught by full-time faculty members and graduate assistants).

This combination of lecture or lecture-demonstration and recitation periods appears to be manageable and appropriate for use in many courses. It also provides an opportunity for advanced students to make a gradual approach to teaching. In fact, teacher training could be an important function of this pattern of instruction. These assistants usually work closely with the professor who presents the lecture-demonstrations and thus they can provide him with a useful amount of information about how the course is being received by students, while they gain valuable understanding and skills in teaching methods and course planning procedures.

The duties of these teaching assistants may cover a wide range and relieve the principal instructor of some of his burdens. They may include: leading discussions, keeping attendance records, distributing or collecting papers, answering questions, reading students' papers or correcting their exercises, proctoring examinations, writing examination questions, grading examinations, tutoring students individually, observing student behavior, maintaining discipline, and operation of the question-answer communication system.

Provision for Tutorial Sessions Conducted by Seniors. It has been observed in families that older children frequently assist in teaching the younger children and that in colleges good students are often called on informally to help other students with their study problems.

On the basis of these observations it was considered worthwhile to develop a plan in conjunction with a televised course that would formally utilize the experience, interest and abilities of senior students to help those who are just beginning a particular field of study. The General Psychology course in the spring of 1956 was selected for a trial of this concept. Eight seniors, who were majoring in psychology, were selected on the basis of scholarship and interest by faculty nominations to act as counselors and tutors for those students (mostly freshmen and sophomores) who needed help in the General Psychology course offered on television. These seniors were paid $1.00 per hour for their services. The initial plan was to identify all students who made a failing grade on the first test in the course, which was given about four weeks after the beginning of the semester, and to schedule meetings between these students and the seniors who would try to help them with course-related problems. Further, it was stated that any student in the course who so desired could obtain or request this kind of assistance.

During the semester approximately 300 contacts were made with students either individually or in small groups. No experimental evaluation was planned, but some subjective reactions are available.

The success of the tutorials was, to a large extent, a function of the competence and interest of the individual senior. Some were able to review key concepts very well; others gave answers only to specific questions. Some were more zealous than others in seeking out and making appointments with students who needed help. In this connection the greatest problem of the procedure should be mentioned; namely, the difficulty of arranging meeting times in the midst of the students' crowded schedules and the difficulty of finding suitable meeting places.

It was noted that the desire of students for these tutorials increased just before each examination, and many of the students expressed appreciation for the help they had received from the seniors. They were also pleased to have someone who was personally interested in their problems and progress in the course. On the other hand, some of the students who were making poor grades in the course actually resisted attempts to give them assistance.

It was generally agreed by those working closely with the Project that the procedure should be followed in the future. However, this was not done in psychology because of the nature of the experimentation for the next two semesters. This required that every effort be made to reduce the leveling effects of influences such as textbooks and tutorials.

More recently it has been considered worthwhile to expand this kind of procedure on a broader basis, and support has been obtained from the Fund for the Advancement of Education for a project which will eventually involve all students majoring in the field of psychology. In this project a model procedure may be developed which could be used for large class sections taught over television. The intention of this project and other adapted patterns of televised instruction is to provide for personal interactions and social reinforcement of serious academic efforts, and thus to compensate for

FIGURE 5. RECEIVING ROOM SHOWING DETAIL OF RECEIVER STANDS AND AVAILABILITY OF STUDENT MICROPHONE ON TABLE FOR QUESTION AND ANSWER SYSTEM. MICROPHONE IS PASSED TO STUDENT WISHING TO ASK QUESTION

possible limitations imposed by television on interactions between teachers and students and among students themselves.

The Use of Question-Answer Procedures in Television Sections

Under the general heading of providing for discussion in TV classes, another method of providing for contact between students and teacher was tried; namely, the use of an intercommunication or question and answer "talk-back" system which permits students in TV rooms to ask questions of the teacher or to respond to questions asked of them.

This procedure was first tested in the Air Science (ROTC) course during the fall of 1955.[1] Two classrooms were equipped with microphones on long cords, two other classrooms not so equipped were available for comparison. The microphones were connected to a headset in the originating room so that the instructor could hear questions without any problem of "feedback" caused by a loudspeaker feeding signals into a microphone. At appropriate intervals during his presentation the instructor would pause, put on the headset, and invite questions from each room equipped with a microphone. He would then repeat each question so that all students could hear it, then he would give an answer. Although this system may appear to be rather cumbersome, it worked fairly well in practice and a number of questions were asked and answered (28 questions in 6 sessions). A comparison of achievement scores and of scores on a scale designed to measure attitudes towards the Air Force showed no significant differences between the groups that were provided with microphones.

Ideally, a two-way communication system should be so constructed as to permit any student to signal the instructor

1 This experiment is described more fully in Chapter 2, p. 30.

TABLE 59

Reactions of Students to Use of Question-Answer Communication System in TV Classrooms for Five Courses in Spring of 1957

Question	*Economics 2* N = 220	*Education 1* N = 93	*Music 5* N = 130	*Meteorology 300* N = 58	*Accounting 1* N = 160
1. During the periods when a microphone was available:					
I liked the idea very much	23%	53%	47%	26%	69%
I liked the idea somewhat	25%	26%	20%	24%	20%
I neither liked nor disliked the idea	49%	17%	32%	43%	8%
I disliked the idea somewhat	2%	2%	1%	2%	1.5%
I disliked the idea very much	1%	2%	0%	5%	1.5%
2. I think having a microphone available in this course:					
Significantly lowered my achievement	.5%	3%	0%	2%	2%
Somewhat lowered my achievement	1.2%	2%	3%	2%	3%
Did not affect my achievement	84%	53%	75%	83%	32%
Somewhat improved my achievement	13%	37%	18%	13%	50%
Significantly improved my achievement	1.3%	5%	4%	0%	13%
3. With regard to future courses presented over TV, I think a microphone:					
Definitely should be used	36%	65%	60%	37%	77%
Probably should be used	31%	25%	18%	40%	15%
Would make little difference	29%	6%	22%	19%	5%
Probably should not be used	3%	1%	0%	2%	2%
Definitely should not be used	1%	3%	0%	2%	1%
4. Check the statement which indicates how often you personally used the microphone to ask a question (either directly or through a class assistant)					
Frequently	3%	4%	1%	0%	1%
Sometimes	1%	11%	3%	0%	17%
Once in a while	2%	18%	10%	6%	25%
Hardly ever	9%	28%	15%	13%	22%
Never	85%	39%	71%	81%	35%

and ask a question. Also, the instructor should be able to indicate to the student when he is ready to respond to the question. Furthermore it is desirable for the instructor to have control over the exchange so that he can time and terminate the questioning. In order to give this two-way communication concept a more thorough trial, a system was designed and built to specifications by a senior engineering student at Penn State.[1] The system includes a control box located on the instructor's desk in the TV originating room. This box contains a signal light and spring-loaded switch for each room. A small portable microphone box was provided for each classroom (see figure). This box contains a small dynamic microphone, two indicator lights and a push-button.

The system operates in the following manner: A student who wishes to ask a question raises his hand and the teaching assistant or other students pass him the microphone. The student then pushes a button which lights the corresponding light on the teacher's control box. It also lights a "stand-by" light on the student's box. When the instructor is ready to accept the question, he pushes the switch on his control box. This action performs several functions:

(1) It lights a green "talk" light on the student's microphone.

(2) It cuts off the loudspeaker in the student's classroom to prevent audio "feedback."

(3) It disconnects the instructor's microphone and connects a loudspeaker in the originating room.

Thus, the student's question can be heard clearly in all of the other classrooms and by the instructor in the originating room. To reply, the instructor merely releases his control switch and talks in the unusual way over his microphone.

The system has worked very satisfactorily from the mechanical and electrical points of view. The extent of its use in courses has been a function of the degree of encouragement to ask questions that students have received from their instructor, the nature of the course, and the manner and style of the instructor's work. Frequency of questioning has been higher in courses where there is much detailed and precise

[1] A separate report describing this two-way communication system is available from The Pennsylvania State University. See James T. Raleigh, Notes on a Communication System for Use With Closed-Circuit Television Instruction.

information, e.g., Elementary Accounting, and lower in courses that deal with general principles such as General Psychology and Principles of Economics. However, in these latter courses the number of questions asked appeared to be a function of the topic being taught. Also, to some extent, students have to learn to make use of the system. In other words, they need encouragement, and a suitable climate for its use has to be established in order to reduce inhibition. This situation existed in several courses at Penn State.

Six classrooms in the Sparks Building were equipped with the inter-communication system. During the Spring Semester of 1957 an effort was again made to evaluate two-way communication both in terms of effects on achievement and acceptability to students. In Principles of Economics an experiment was conducted in which a comparison was made between the performance of students in rooms equipped with microphones, and the performance of students in rooms not so equipped. This project was described in Chapter 2, pp. 29-30. No significant differences in performances were found as a result of this variation of methods.

In five courses students were polled for their opinions on the usefulness of the inter-communication system and the extent to which each personally used the system. The responses to these questionnaires are summarized in Table 59.

As can be seen from the table, the results for the different courses are fairly consistent. Students generally liked the idea of having a two-way communication system available; the majority thought that it did not affect their grade in the course. They tended to think that it should be used in future courses and by far the majority of students "hardly ever" or "never" used the system. Use of the system was most extensive in Elementary Accounting where the students asked questions of the teaching assistant in each room who then relayed the question, if important, to the instructor. The next most extensive use was in Introduction to Education where the professor asked questions to which the students responded over the microphone system.

On the basis of experience with the use of two-way communication so far, it would appear that its use has little or no effect on students' achievement in most courses. On the other hand, the presence of such a system is liked by both students and faculty; it seems to eliminate or reduce a deprivation most frequently referred to by critics of television teaching (the inability of the student to communicate directly with the instructor). Therefore, a two-way communication system may have importance in gaining acceptance for the use of television. It is possible in some courses where there is a need for students to ask for frequent clarification or repetition of points, e.g., Accounting, Mathemetics, that the system may play an important role in learning, but this still needs to be established by experimental evidence.

It might be hypothesized that many students who have questions find the answers by methods other than asking their instructor; namely, by referring to their textbooks, or by discussions with other students out of class. It is possible, if this is so, that the use of television forces students to do more work on their own. Furthermore, it should be noted that in TV sections which may include hundreds of students, it is important to ensure that pertinent questions contributory to the teaching-learning processes are asked and that irrelevant questioning is reduced. Time in such a class is very valuable. Finally, it should be observed that question-answer exchanges are very different from and should not be confused with intensive, extended and provocative discussion.

Provision of Class Notes for Students

During the first semester's use of television in the General Chemistry course (spring 1955), students in the TV sections frequently complained that they had difficulty in taking notes. Inquiries revealed that it was the practice of many students in conventional face-to-face classes in chemistry to watch the instructor while he was developing a topic, which usually involved chemical equations written on the blackboard. Then, at the conclusion of the development, students would take notes on the material still on the blackboard, while the instructor was developing the next topic. Such a procedure was not possible with the televised presentations. While every effort was made to hold the television cameras on the blackboard material as long as possible, whenever the instructor turned to a new topic, the cameras followed him, and the previous material was no longer visible to the students in the TV classrooms.

In considering this problem, the conclusion was reached that it was psychologically unsound for students to divide their attention between taking notes on a previous topic, and trying to follow the instructor in the development of new concepts. Furthermore, other research studies have shown that taking notes during the presentation of instruction can adversely affect learning, especially if the rate of presentation of the material is fairly rapid (as it was in chemistry).

It was decided therefore to provide the students in this course during the next semester (Fall Semester of 1955) with mimeographed notes which briefly outlined the topic to be covered in the lecture, gave references to the textbook, and other data or special information not readily available to the student. Generally, the mimeographed notes for each lecture-demonstration did not exceed two pages. They were made available to students as they entered the classrooms.

An effort was made to evaluate the usefulness of these notes by making them available to all students in the course, both when they were taking the course over television and when they were taking it directly in the lecture hall. This procedure was adopted for both sections of the course.

After a period of about five weeks, all students who had received the notes filled out a questionnaire which sought information about the difficulty of taking notes in chemistry, and comparisons were made between the responses of students in TV rooms and those receiving direct instruction in the lecture hall.

These responses are summarized in Table 60.

TABLE 60

RESPONSES OF STUDENTS TO PROBLEMS OF TAKING NOTES IN GENERAL CHEMISTRY

	Non-TV Students	*TV Students*
Question 1. What do you think about the problem of taking notes during Chemistry 1 lectures?		
It's very easy	10.8%	15.9%
It's fairly easy	74.5%	65.9%
It's fairly difficult	14.3%	18.1%
It's very difficult	.4%	.1%
Question 2. What do you think about the mimeographed lecture outlines provided?		
Very helpful	53.5%	49.9%
Fairly helpful	38.6%	43.8%
Not very helpful	7.5%	4.8%
Very little help	.4%	1.5%

It will be seen that by far the majority of students indicated they had little difficulty with note-taking, and most students found the lecture outlines helpful. The differences in responses between the non-TV and TV groups were small. However, when prepared notes were given to students, reports of difficulties with note-taking in chemistry ceased. The practice has become a regular procedure in this course, even though it is not now taught over television.

This practice of giving the students lecture outlines would appear to be worthwhile, and should probably be extended to other courses. It has been followed to some extent in televised courses in economics and accounting.

Varied Amounts and Kinds of Proctoring

One of the subjects studied under the general heading of adapting courses to television was the use of proctors or teaching assistants. Several experiments were conducted in the Fall Semester of 1955 in which the amount of proctoring was varied, while others varied the status of the proctors. These experiments were described in the previous chapter. Where the job of the proctor was confined to taking roll, handling assignments, and maintaining order (if necessary), no effects on achievement were discovered as a result of varying the amount of proctoring, or using people of differing status as TV classroom supervisors. In these experiments the proctors did not do any teaching beyond giving an occasional brief answer to a student's question.

During the past two years, however, teaching assistants have been used in a number of courses to perform a variety of duties. Their functions were described earlier in a section on Patterns of Instruction.

Use of Teams of Instructors

One of the possibilities offered by television is that of using several instructors as a team to teach a course. By consolidating a number of sections of a course into one television section, it is possible to have a plan whereby several instructors teach the topics of the course in which they are particularly well qualified or interested, or take turns in teaching parts of the course and thus gain time for other activities such as research, professional development, course improvement, or an adjusted teaching load.

Another advantage of this plan is that the members of the teaching team can observe one another's teaching and can offer constructive suggestions for the improvement of teaching.

This plan has been used in three TV courses at Penn State: General Chemistry, General Psychology and Air Science. Other courses, particularly Introductory Sociology and Principles of Economics, have used visiting speakers from time to time, usually in an interview situation.

In General Chemistry, during the two semesters that the course was offered over television, three instructors taught the course. They rotated on a scheduled basis (each in turn gave a series of three lectures), rather than on the basis of preference for subject matter. Each member of the team observed the teaching procedures of the others over television and some fruitful discussions were held afterwards.

In General Psychology during the first semester on television (Spring Semester of 1955) two teachers each taught a different television section of the entire course. The team idea was tried out again in the Fall Semester of 1955 when five teachers gave the course over television. Each taught the part of the course in which he was most interested and qualified. While this procedure of having specialists teach various sections of the course appeared to be a desirable one, informally-gathered student reactions indicated some objections to the method. Those objecting said that they had difficulty adjusting to the different styles of teaching and to the different instructors. About the time that they were becoming accustomed to a teacher, and were learning to judge what he considered to be important, the first teacher would finish his section of the course and a new one would appear.

A different plan was used in General Psychology during the following semester (Spring Semester of 1956). Three teachers constituted the team, each teaching the section of the course in which he was most interested and qualified. One member of the team, in addition, acted as coordinator, introducing the other members and filling in gaps in instruction from time to time. Toward the end of the semester student reactions to this approach were obtained by a questionnaire. The responses showed that the students were generally favorable to and satisfied with a team of three instructors.

Subsequently two instructors have shared responsibility for the TV sections in General Psychology. The course was divided between them on the basis of subject matter, and occasional guest professors and specialists were invited to teach sessions of the course.

In the Air Science course, two instructors have worked together as a team ever since the course was first offered on television in the Fall Semester of 1955.

Each professor taught a part of each day's lesson, and they frequently appeared together in a discussion or role-playing

instructor prefers it, a projector and screen may be set up to one side of the studio where direct light does not hit the screen. The projected image is then televised by locating a TV camera alongside the projector. This arrangement has two advantages: (1) the instructor can easily use a pointer and (2) a close-up of portions of any slide can be obtained simply by turning the turret on the TV camera to use a different focal length lens. A projector with a 750-watt lamp is desirable.

Motion Pictures. Motion pictures are employed quite extensively in televised courses for which suitable films are available. The films are projected from the TV control room. It is quite practical for an instructor to arrange to have parts of the same or several films shown during a class period. Each film is wound through to the pre-arranged starting point. This is done in the control room, where the process does not disturb anyone as it would in a regular classroom.

The films are usually obtained from the University's audio-visual library. The use of television is undoubtedly having an effect on the use of the library's facilities and, although no exact data are yet available, several trends are apparent:

(1) The projection of films on TV is reducing the demand for projectors and projectionists in the courses now on television.

(2) Generally, more films are being used in courses that are televised than were used in the same courses before they were presented on television (e.g., General Psychology, Introduction to Education, and Air Science).

(3) However, the number of uses of a given print is less because of the fact that one or two showings on TV are all that are necessary to reach a very large number of students.

(4) The projection of films in a number of classrooms from a central room in a building, or even from the audio-visual library by means of television, has considerable possibilities for the future.

Ordinarily a film chain for the projection of films on television requires the use of a special projector along with a slide projector linked together optically through a multiplexer with a special television camera. The use of a regular 16 mm projector introduces an unacceptable amount of flicker into the system. In an effort to develop an inexpensive film chain, several modifications of the shutter of a regular projector were tested, with the picture being projected onto a screen from which it was televised by the TV camera. After a number of fruitless attempts to obtain a flicker-free picture, it was suggested that a regular projector be tried with no shutter at all.[1] Accordingly the shutter was removed from a standard Navy JAN SPEC projector and the resulting picture on the screen was televised with a regular TV camera with entirely acceptable results. Although the picture looked blurred on the motion picture screen, it televised very satisfactorily with no noticeable flicker. The convenience of the arrangement was improved by projecting the picture onto a translucent rear-projection screen by way of a mirror. The projector and screen were located in the studio away from the "spill" of the television lighting.

Diagrams, Graphs and Title Cards. In a number of courses at Penn State, instructors wished to use diagrams, graphs, or printed title cards listing main topics to be covered in a given lesson.

Several ways of preparing these materials were used. When the need first became apparent, a graduate student who was skilled in sketching and freehand lettering was hired on a part-time basis and made available for the TV instructors. Several people made use of his services, but circumstances made it necessary for requests to be submitted to him at least three days before the material was to be available. This restricted the use that was made of his services.

Teachers tried several methods of producing their own diagrams or lettered cards. The TV Project provided them with a supply of poster cards and a magic marker felt-pointed pen. Most people found that they could produce graphs, diagrams, or printed cards quickly and satisfactorily. Generally, black ink was used on light blue or gray cards, and the results televised extremely well. The majority of instructors at Penn State used this method. A staff artist is still available and produces sketches for special occasions, especially when the lesson is to be recorded on film. A show-card lettering press with wooden letters in several sizes is also available and is used for the same purpose. This press greatly facilitates the preparation of title cards. Some instructors use a standard typewriter with a good black ribbon for the preparation of outlines and tables. Generally, with typewritten material the lines should not exceed four inches in length.

Other Facilities. For the purpose of displaying diagrams, clippings and still pictures a cork bulletin board is available in the principal TV originating room. In addition, there is a small table easel for displaying books and a larger easel for holding small objects. An overhead projector is available and has been used occasionally for projecting large transparencies, translucent solutions, and diagrams prepared with a wax pencil. Several lavalier chest microphones are available for panel discussions. Apparatus for demonstrations is secured as needed.

Analysis of Types of Presentations. A special effort was made during the Fall Semester of 1955 to encourage the use of a variety of teaching materials. It is probably true to say that since that time there has been a steady growth in the use of audio-visual materials in TV courses. During that particular semester, however, a record was made of the kinds of materials used in the various courses offered on television over the system in Sparks Building. This analysis is shown in Table 61.

[1] The suggestion was made by Dr. Loran Twyford of the Naval Training Devices Center.

situation. It is generally believed that such an arrangement provides a change of pace and stimulates the interest and attention of the students.

During the Spring Semester of 1957 a team of two instructors taught a single television section which included all of the 810 sophomore students enrolled in the Air Science course. In addition to this work both were able to spend an increased amount of time in their offices and were available for assisting individuals and small groups of students.

The team approach would appear to have much to recommend it. There are, however, several points to be considered if it is to be used:

(1) There should not be too many different people combining to teach a given course; two or three is probably the optimum number for most courses.

(2) It may be necessary for one member of the team to act as coordinator so that the course does not become disorganized.

(3) The members of the team should define and agree to their responsibilities ahead of time—not only about subject matter coverage, but also questions of course development, course management, preparing examinations, grading papers and assisting individual students.

(4) It is desirable for the team of teachers to invest adequate time working together out of class to plan and integrate their instruction.

(5) A most valuable asset of several individuals working together is the opportunity thus created for constructive analysis and critique of each other's teaching and for the training of junior members of the team and assistants.

Provision of Graphic, Pictorial and Demonstration Materials

The use of television for classroom instruction opens up considerable possibilities for the use of graphic, pictorial and demonstration materials. The ease with which such materials (even those which are small in size) can be shown to large groups makes it very practical for teachers to use a wide variety of materials. Even the use of motion pictures is facilitated by television. In comparison with the effort required to show a particular film to say, fifteen sections of fifty students each, the effort expended in using television is relatively small. Film scheduling problems are greatly reduced. The number of projectors and operators is also greatly reduced. There is no necessity to darken the classrooms. The film can be put on the TV film projector in the control room, and when the instructor is ready to use it he simply calls for it and the film appears in all of the receiving rooms with no delay and no disturbance or interference noticeable in the classrooms.

The same kinds of opportunities apply to the use of other kinds of visual materials. While it is true that small photographs or diagrams from books, magazines, or other sources can be copied onto slides and projected for classroom use, experience has shown that relatively few teachers take the time to do this. In the first place, there has to be a convenient facility for slide making, then the teacher must select the materials well in advance in order to have the slides ready in time. Next, there may not be enough projection equipment to handle courses which enroll, say, 800 to 1,000 students. Then, there is the matter of the difficulty of using current material for slides. Teachers of many courses would like to use new and different current materials every semester but this is impractical in most cases where the preparation of slides is involved. Finally, it is well known that it is difficult to present many kinds of demonstrations using laboratory apparatus to groups of students. Such difficulties relate both to the availability of the apparatus and the clear presentation of the crucial aspects of the demonstration. In many courses it is impossible to stage demonstrations for sections of courses widely dispersed in time and in different buildings of the University.

Experience at Penn State indicates that television on the other hand offers good possibilities for revitalizing the use of audio-visual materials. Not only is it easy to use such materials when television is available, but television's video channel provides a constant invitation to use such materials.

At Penn State a fairly generally accepted philosophy is that visual materials are used on television when, in the best judgment of those concerned, they will contribute to the learning process. They are not used merely to fill the time available over the video channel. Visual materials are used to present experiences and stimulation that could not otherwise be provided, to reinforce verbal concepts, to relate principles to current events, and to clarify complex concepts. There are times when their use may be justified for concentrating attention or providing a change of teaching pace. They are also used to aid discrimination learning on the part of students.

A brief description will be given of the kinds of materials used on closed-circuit television at Penn State and how they are produced.

Still Pictures. Many instructors like to relate principles to daily events, and to do this they make considerable use of pictures clipped from newspapers and current magazines. Such clippings are pinned upon a cork bulletin board in the TV originating room. At such time as the instructor wishes to refer to them, a television camera picks them up and relays them to the classroom. Other instructors have built up files of photographs or picture post cards which are appropriate for classroom use and are easily presented via television. Similiarly, illustrations from books can be shown without mutilating the book. In general, such pictures should be horizontal in format with a proportion of three units in height to four units in width. Considerable deviations from these ideal proportions can, however, be tolerated. Pictures varying in size from that of a postage stamp to 30" x 40" have been successfully televised.

Slides and Film Strips. Lantern slides, either 2" x 2" or 3¼" x 4", and 35 mm film strips are used in televised courses. The smaller slides and filmstrips may be projected over the television film chain from the control room. However, if the

TABLE 61

Types of Instructional Presentations Over Television

Fall Semester 1955

SPARKS BUILDING

	Psych. 2	*Psych. 17*	*Ed. 1*	*Econ. 2*	*Music 5*	*Speech 200*	*Com. 30*	*Air Sci. 3*	*Total*
Total Hours of TV During Semester	74	39	19	33	43	15	35	24	282
Straight Lectures	34	39	0	1	0	3	34	0	111
Other Types of Presentation	40	0	19	32	43	12	1	24	171
Graphic Visuals	24	0	5	32	43	5	1	12	122
Demonstrations	8	0	2	0	12	0	1	0	23
Panels	2	0	9	0	0	1	0	4	16
Films	6	0	1	0	2	0	0	14	23
Dramatic	0	0	1	0	0	0	0	2	3
Film Strips	0	0	0	1	0	0	0	0	1
Interviews	0	0	1	0	0	0	0	2	3
TV Quizzes	0	0	1	3	2	0	0	8	14

Incidental Adaptations and Uses of Television

During the period that television has been available at Penn State there has been a continuous exploration for other appropriate uses of the medium in addition to classroom instruction. These have included projecting the administration or interpretation of tests, applications to the microscope, remote viewing of special events and for courses in professional training in television techniques. Several of these applications will be discussed.

Presenting Tests

Television presents numerous possibilities for the presentation of tests to large numbers of students. At the simplest level it was thought that objective type tests with multiple-choice questions could be presented on television with a resultant saving in the printing of several hundred test booklets, improved security of the tests and providing a controlled rate of presentation of items. This arrangement was tried out in two courses during the Spring Semester 1957—General Psychology and Air Science.

General Psychology. In General Psychology the idea was tested on a trial basis. A part of one of the examinations during the semester was presented on TV. The remainder was given in the usual way.

It was found to be difficult to keep the test items short in this course, especially since an effort was being made to develop items that would test for comprehension and application of what was learned to new situations, rather than for simple recognition of facts. Based on a maximum viewing distance of twelve screen widths, it was found by test that a typewritten line should not exceed four inches in length. Thus in a 3″ x 4″ format about five or six lines were all that could be included. This provided only for a short stem and four choices for each item. For some items several parts were presented in successive cards. First, the stem would be presented by one camera. Then, after a suitable reading time, the choices would be given over camera two. The stem and choices could be shown once more if necessary. This first trial was judged to be moderately successful. Students disliked the idea of not being able to go back over the test to alter their first answers, but generally they managed to cope with the new method of presentation and no adverse effects were found in grades.

Air Science. The procedure was next given a more thorough test in the Air Science course. Fifty four-choice objective type items were prepared. They were all sufficiently short so that each item could be presented completely at one time. They were arranged in two lists—the odd numbered items in one, and the even numbered in the other. This permitted the use of a separate camera on each list so that no time was lost going from one item to the next. The length of time of presentation of each item was standardized at forty seconds.

In order to gain some information about the relative difficulty of two methods of presentation of test items over television and in standard mimeographed form, an experiment was conducted. From the entire population of 810 students, two groups of 100 were randomly selected. One of these groups was given the test in conventional form, while the other group took the test over television along with the remaining 610 students. An equal total time was given to both groups. The adjusted means of the two groups were as follows:

Televised test	26.46
Conventional Test	27.47

The statistical analysis indicated that the method of administering the examination had no significant effect on the scores obtained by the two groups.

A random sampling of cadets reported in interviews that the televised test moved too slowly for some, too rapidly for others and was somewhat difficult to read by still others. All cadets had received some experience with televised testing through a prior series of lesson quizzes given by the same method. The majority disliked not being able to skip items for later review and completion.

A second multiple-choice type examination was given in the final block of instruction over television. All cadets were tested simultaneously. One hundred items were used but only the stems of the items were televised. IBM answer sheets were used and each cadet referred to the blackboard in the viewing room for the four response choices, one of which was the most nearly correct for each of the 100 stems appearing on the screen; the choices were quickly memorized. Fifty stems were in the form of pictures, models, diagrams, maps, photos, cartoons, etc. and 50 stems were conventional descriptive phrases, principles, applications, etc. designed to determine the cadets' overall grasp of the concepts within the four major areas studied (the four choices). Only twenty seconds' time was allowed for each item to appear on the screen and there was no delay between items. Each succeeding item was announced by voicing the number which also appeared on the stem. All printing for the televised items was done with a felt pen eliminating all typing and test booklets.

Cadet reaction to this testing experience was quite favorable with an insignificant number commenting on any unfavorable aspects related to television.

It appears practical and highly feasible to present tests and examinations by television whenever a valid and reliable test can be constructed that is appropriate or can be adapted to television. Such testing as is described above appears quite effective in evaluating student retention and understanding of material presented. The distribution curve of scores made in the televised examinations exhibited the same characteristics as did curves of scores on conventionally administered examinations. Furthermore, the duplicating of large numbers of test booklets is eliminated.

Other Possibilities for Tests. Methods have been worked out for presenting a performance-type test on television, but so far the opportunity has not occurred to permit a trial. It is believed that in a course such as chemistry or electrical engineering which involves laboratory work, it should be possible to present demonstrations over television that involve problems that students are required to solve. In 1953 the Instructional Film Research Program at Penn State produced a performance-type test on film. Performances were presented both in pictures and sound, and the students were required to diagnose problems, point out errors, indicate the next step in a sequence of action and so forth. It is planned that a similar test will be tried on television in the near future.

Interpretation of Freshman Tests. For some years all entering freshmen at Penn State have been given a battery of tests during the first week of the school year with the purpose, among other things, of giving them guidance in choice of curricula.

Ordinarily, throughout the freshman year, students would be brought together in groups of ten to fifteen to have their test scores interpreted. This operation was very time consuming, and considering the fact that it might involve three to four thousand freshmen, it took almost a year to complete the interpretation—too late to be useful for some purposes.

For the past two years these interpretations have been given over television with a considerable saving of time and a great increase in the rapidity with which the information was made available to the students for use in course and curriculum selection. The operation was performed as follows: The students' scores were punched on standard IBM cards. Meetings of groups of about 300-400 students at a time were scheduled in the evening in the TV classrooms. Each student had an IBM card with his own scores punched on it. From the originating room an experienced test interpreter explained the purpose of each test, and then several IBM cards were televised showing different score patterns on each test. (It was necessary to televise only a part of the card at a time.) The significance of these patterns was explained and the student compared his own card with the examples shown. This procedure was repeated for the several tests and interpretations of typical overall patterns of scores were made. Several members of the staff or graduate students in psychology with experience in test interpretation were on hand to deal with individual problems at the close of the TV presentation.

The IBM cards televised satisfactorily and the punched holes could be clearly seen on the 24" TV screens. All freshmen could be given their test in five or six evenings. This operation was judged to be completely successful.

Professional Television Training

The Penn State closed-circuit television systems have been used by several departments for courses designed to train students in various kinds of television techniques.

Principles of Television Speech. The Speech Department offers a course in television production techniques for students who hope to work in educational or commercial television stations. The course covers the planning, writing and production of television programs of an educational nature. Students gain some proficiency also in camera operation and directing. The laboratory part of this course makes use of the closed-circuit facility.

Advanced Radio and Television Drama. This course, taught by members of the TV Project staff, under the auspices of the Drama Department was aimed primarily at training students in closed-circuit operations for instructional purposes. Penn State has received a number of requests from other educational institutions for TV coordinators, and it was considered worthwhile to offer a course to train people for this kind of work.

Radio and Television in Education. This advanced course in education is primarily for teachers who may be in charge of audio-visual or television activities in their schools, or who may have to appear in front of the television camera to teach classes. The laboratory part of the course used the television system.

Homemaking (Home Economics.) The Home Economics College trains girls to present homemaking demonstrations on television. The laboratory part of this course also used the University's closed-circuit facilities.

Radio and Television Advertising (Journalism). The course in television advertising offered by the School of Journalism likewise used the TV facilities for laboratory work.

The demand for professional training has increased to the point where it has been considered desirable to provide a separate vidicon TV system for teaching the courses listed above. Plans are being made to install this system in the new classroom building for the Fall Semester 1957. The system will occupy an originating room and control room with receiver connections in an adjoining classroom. This arrangement will be a second main system operated in parallel with the one in the Sparks Building which will permit the scheduling of additional courses over television and serve professional training.

Research on Improvement of Televised Courses

It has already been indicated in this section of the report that teachers, in most courses offered over television, are making increased use of a wide variety of teaching materials. This is part of a continuing program of adapting the courses to take advantage of the potentials of television. From time to time in most televised courses students are invited to fill out a questionnaire designed to elicit their constructive reactions to the televised presentations, and to obtain suggestions for improving both the course and its presentation.

Summaries of responses to relevant questions from several typical questionnaires administered in representative courses will be given below:

Elementary Accounting presented over TV, Spring Semester, 1956 (N = 166)

Q. In your opinion new material in this course is presented:

Response		*Most frequent comments*	*Frequency of comments*
Too fast	11%	The material is covered well	30
About right	86%	Occasionally too fast	12
Too slow	3%	Too much repetition of simple material	11
		More time is needed	10

Q. I find the presentation is:

Response		*Most frequent comments*	*Frequency of comments*
Well organized	90%	Well organized as presented	42
Confusing	10%	Occasionally confusing	24

Q. Do you feel that your instructor's method of presenting material is:

Response		*Most frequent comments*	*Frequency of comments*
Over simplified	11%	Well presented	26
About right	87%	Too much emphasis on simple material, not enough	
Too complicated	2%	on difficult	17

Q. The typewritten materials presented over television (journal entries, ledger postings, etc.) are:

Response		*Most frequent comments*	*Frequency of comments*
Readable	92%	Camera on material too short a time	26
Unreadable	8%	Usually material is readable	24
		Material hard to read	17
		Very neat and legible	11

Q. The blackboard work is:

Response		*Most frequent comments*	*Frequency of comments*
Readable	97%	Material usually readable	18
Unreadable	3%	Board work occasionally confusing	11
		Board work very neat and clear	10

Q. In order to learn this material I rely most heavily on:

Response		*Most frequent comments*	*Frequency of comments*
The instructor's lectures	27%	The laboratory sessions are poor	33
Textbook	43%	Get most out of text	31
The laboratory sessions	2%	Get most out of lectures and text	26
A combination of the three	28%		

General suggestions about presenting Elementary Accounting on TV:

Most frequent comments	*Frequency of comments*
Can't ask questions	31
Laboratory sessions poor	19
Not a good course for TV	18
Well presented course	15
Homework not gone over or graded	10

It is clear that in the spring of 1956 most students were satisfied with the lecture presentations over television, but not with the laboratory sessions. They would also have liked to be able to ask questions. The laboratory sessions were reorganized in the following semester, but a two-way communication system was not available in this course until the spring of 1957.

A questionnaire was filled out by the students taking the course during the Fall Semester of 1956. The most important responses are summarized below.

Elementary Accounting presented over TV, Fall Semester, 1956 (N = 210)

Q. What have you liked most about the presentation of Elementary Accounting this semester?

Most frequent comments	*Frequency of comments*
Good close ups	35
Good lectures	23
Effective explanations	23
Use of examples	21
Good rate of presentation	19
Covers everything	18

Q. What have you liked least in the presentation of Elementary Accounting so far this semester?

Most frequent comments	*Frequency of comments*
Can't ask questions when they arise	76
Homework not corrected and returned	20
Television	14
Lectures go too fast	14
Too much repetition	10
Laboratory period	10

Q. In the spaces below indicate how effective you find the textbook, the instructor's lectures and the laboratory session as aids to learning accounting:

	Frequency of comment		
Response	*Text*	*Lectures*	*Laboratories*
Very helpful	130	131	47
Somewhat helpful	76	63	104
Not at all helpful	3	15	58

Most frequent comments	*Frequency of comments*
Laboratory not helpful	30
Text very poor	30
Lecture explains and elaborates text	19
The three together are ample	18
Lectures very good	15
Text not clear enough	10

Q. Do you think that you get enough help on specific questions and problems in laboratory?

Response	*Most frequent comments*	*Frequency of comments*
Ample help is provided 32%	Help is there if you need it	21
Help is sufficient 49%	Not enough help	15
Not enough help 19%	Help is poorly presented	13
	Too many people to receive enough help	12
	Laboratory is good	10
	Laboratory instructors helpful	10
	Stress the more difficult items in text	17
	Do not give course on TV	15
	Room 10 is stuffy and overcrowded	13
	Improve panel discussion presentations	10
	Better close ups of small printed materials	10

The laboratory sessions were generally devoted to assigned accounting problems. Groups of about 40 students were supervised by a graduate assistant.

Principles of Economics presented over TV, Spring Semester, 1956 (N = 333)

Q. What suggestions do you have for improving the presentation of this course on TV?

Most frequent comments	*Frequency of comments*
Closer relationship between text and lectures	66
Some facility for asking questions (other than in laboratory sessions)	60
More use of examples (movies, slides, etc.)	57
Have fewer students in Room 10 (auditorium used as one of the receiving rooms), or do not use at all	25
Better control of students in receiving rooms	23
Technical improvements	18

Again, the need to provide a method for asking questions is stressed.

Introductory Sociology presented over TV, Fall Semester, 1956 (N = 165)

Reactions of students to:

Presentations	*Frequency*
Well organized, clear presentation	126
Effective use of visuals	38
Content interesting	33
Effective use of guest speakers	17
Lectures below level of students	8
Well organized, but lacking in interest	6
Course Content	
Good, broad in scope, useful in every day life	68
Too general	8
Textbook	
Good text, easy to follow	50
Textbook is dry, dull in many places	14
Instructor (personality, voice, mannerisms, enthusiasm, etc.)	
Effective in all or most of above characteristics	132
Gets off subject too often	3
Too general	2
Television as teaching medium for this course	
TV is effective for this course	100
TV not effective for this course	25
No noticeable difference between TV and live	11
Indifferent to TV	2

Considerable work was done to adapt General Psychology to television during the Spring Semester, 1956, especially by using a number of live demonstrations. An effort was made to secure student reactions to the use of these demonstrations. These are summarized below.

General Psychology demonstrations presented over TV, Spring Semester, 1956 (N = 486)

Q. In Psychology 2 this semester a number of demonstrations have been presented over TV to illustrate principles discussed under the headings of Scientific Method, Learning Motivation, Emotion, Perception, Intelligence and Personality. Please list as many of these demonstrations as you can recall. Place an X alongside the three demonstrations which you think contributed most to your understanding of psychology.

Demonstration	*Frequency Mentioned*	*Frequency of X's*
IQ testing	262	166
Rats in Y maze	216	101
Non-directive therapy interview	166	86

Card game with rats introduced	151		59	
Activity wheel (rats)	94		39	
Movie about Claire	91		56	
Rats competing for food	88		41	
Probability demonstration	65		18	
Movie on cats	56		21	
Personality trait movie	49		31	
Projective tests (TAT, etc.)	45		15	
Pictures of people showing emotion	43		15	
Human maze	39		15	
Motor skills (in general)	39		12	
Pursuit rotor		69		16
Wiggley block test		40		6
Finger dexterity		33		3
Minn. rate of manipulation		14		1
Problem solving	39		12	
Perception tests (in general)	34		12	
Numbered papers		51		21
Phi Phenomenon		13		3
Figural after effect		12		3
Squares		10		2
Size by touch		8		1
Jastrow illusion		6		0
Yerkes multiple choice	27		5	
Aptitude testing	24		8	
Maturation (water glasses)	21		6	
Statistics	15		9	
Scientific method	15		9	

Q. What suggestions do you have for improving the demonstrations?

Most frequent comments	*Frequency of comments*
Explain more fully (before, during, and after)	98
Have more demonstrations	43
Very good	42
Make them shorter and more concise	32
Have more movies	15
Some demonstrations poor	11
Deal more with humans, not rats	10

Q. What suggestions do you have for improving the course in general?

Most frequent comments	*Frequency of comments*
Have small non-TV classes	61
Follow textbook more closely	31
Relate exams closer to lectures	27
More movies and demonstrations	26
Keep better order in TV rooms	23
Course is good	21
10 Sparks (large auditorium) too big and too many students	19
Have small discussion groups	18
Have lecture outlines	15
Relate psychology to practical situation	12

Q. What do you think about having a team of three instructors? (A team of three taught this course)

Response	*Frequency*
Three about right	329
Three are too many	131
No response	17
Three too few	8

Most frequent added comments

(a) Those who thought three were about right:	
Three add interest and variety	27
Some were better than others	19
Each well versed in particular field	17
All three good	8
(b) Those who said three instructors too many:	
Problem of adjusting to different instructors	23
One *good* instructor enough	23
Two instructors about right	6

Use of Television as a Demonstration Magnifier in Large Auditoriums

Many universities are equipped with a certain number of large auditoriums seating 200 students or more. One of the disadvantages of these rooms is that students frequently cannot properly see demonstrations or other kinds of teaching materials. The result of this is that instructors refrain from using some kinds of materials (especially demonstrations), or attempt to build large models, or use projected materials or, more frequently, fill only a portion of the room with students.

In such a situation a relatively simple, low-cost television system consisting of a single camera, some lighting, and a number of television receivers located around the room, makes it possible to enlarge demonstrations and other small visual materials so that all students in the room may obtain a good view. This not only permits good utilization of teaching materials, but it also makes it possible to use fully the seating space available.

Some people claim a further advantage. They suggest that this use of TV is a good compromise between teaching a large class conventionally, and teaching from a TV originating room to students who are located in remote receiving rooms. In other words, it is believed that students gain both the benefits of direct personal contact and the close-up views that television can provide.

Three different television systems were used in different buildings at Penn State to study this particular kind of adaptation of television to teaching. One was used in a large auditorium (400 seats) in the Sparks Building for the course Introduction to Education. Another was set up in a science building in a 350-seat auditorium, for use in general chemistry courses. The third system was installed in an auditorium (175 seats) in the electrical engineering building for courses in engineering and electrical engineering.

The uses of the three systems for various courses will be described briefly.

Introduction to Education

A large auditorium in the liberal arts building (Sparks Building) had been equipped as an originating point for television during the first semester of the Penn State TV Project. Hence lights and camera connections were available. This location was used by the instructor for the course Introduction to Education during the Fall and Spring Semesters of 1956 and 1957.

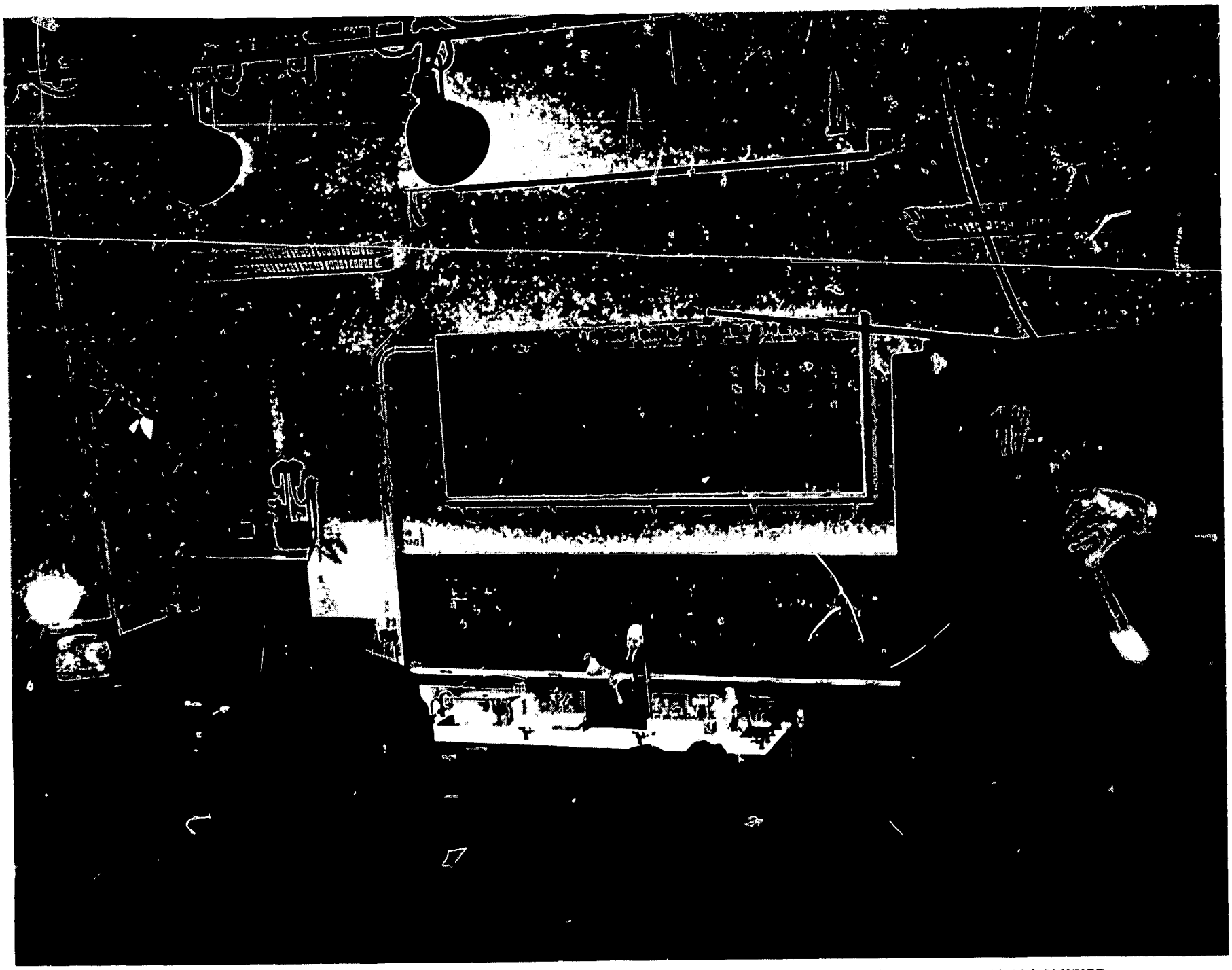


FIGURE 6. LARGE CHEMISTRY AUDITORIUM SHOWING USE OF TELEVISION AS A DEMONSTRATION MAGNIFIER

Six receivers were mounted on stands in the auditorium, two along the sides near the front of the room, and two more in each of two aisles. This arrangement provided a seating capacity for up to 200 students all of whom could obtain a good view of one or more receivers. One Dage professional type vidicon camera was mounted on a tripod at the front and to one-side of the auditorium. A special display easel was constructed for the use of the professor who also employed the television audio system as a public address system. The instructor used television for the presentation of graphs, diagrams, references from books, photographs and sound motion pictures. Students were permitted and encouraged to ask questions during the lectures.

In each semester comparisons were made between this method of using television and the one in which the instruction originated from a small room without students present and was transmitted to a number of TV receiving rooms, each equipped with a two-way communication system. During the Fall Semester the comparisons were made in terms of students' preference for the two methods; in the spring the comparison was made in terms of the relative effects on student achievement of the two methods. These studies are reported in detail in other sections of this report. Briefly, when offered a choice between the two situations, 61 percent chose the small viewing rooms, and 39 percent chose the auditorium use of television. The comparison of the achievement of students taught by each method during the spring of 1957 revealed no significant differences.

General Chemistry

During the first two semesters in which the Chemistry Department used closed-circuit television, the instruction originated in a large auditorium with about 150 students present and was transmitted to several TV receiving rooms where another group of approximately 150 students was seated.

At the conclusion of this phase of the experiment the Chemistry Department elected to test out the "demonstration magnifier function" of television. This procedure has been used for the past three semesters. The lighting originally installed in the auditorium for television was available for continued use. A single Dage model 101-AF "junior professional" camera equipped with side focus and a three lens turret was obtained for use in the auditorium. This camera was mounted either on a fixed stand in the third row of the class, or on occasion on a tripod to one-side of the demonstration table to televise particularly small apparatus such as a PH meter, or the Wilson cloud chamber. Six receivers on stands were located around the walls of the room so that students located anywhere in the 350-seat auditorium could obtain a good view.

The entire system is valued at about $3,500. It was operated by a student. No control room was required.

It was the belief of the chemistry instructors that this system might allow the benefits of direct viewing where color was important, and would provide also a magnified view on television which would make it possible to use large classes (250-300) in the auditorium.

The system has generally worked satisfactorily, although its potential has not been utilized as fully as possible, since many of the demonstrations in chemistry were originally designed for viewing by quite large audiences. It has however permitted an increase in class size.

At the end of the Spring Semester in 1956 a questionnaire was circulated among the students to ascertain their reactions to the use of television to magnify demonstrations in a large lecture auditorium. The responses are summarized below. These students had been exposed the previous semester to televised instruction in small remote TV receiving rooms.

Responses of Students in General Chemistry to Use of Television as Demonstration Magnifier in Large Auditorium (N = 399)

Q. 1. What do you think about TV as used *this semester* in Room 119 Osmond Laboratory to supplement instruction in General Chemistry?

Response	*Entire Group (N = 399)*	*Front half of room*	*Rear half of room*
Very helpful	9%	6%	10%
Fairly helpful	43%	37%	46%
Not very helpful	38%	40%	38%
Useless	10%	17%	6%

Most frequent comments	*Frequency*
(a) By those who said helpful or fairly helpful	
Made experiments clearly visible to those at sides or rear of room	63
Can see minute details and small objects	30
Can see reactions and read meters	25
Demonstrations better on screen than when far away	21
(b) By those who said not very helpful or useless	
No color	45
Close enough to see without TV	43
Didn't make things any clearer	29
More satisfactory to watch instructor directly	26

Q. 2. List some instances in which you thought the use of TV was helpful:

Demonstration of PH meter	178
Model of blast furnace	33
Meters and scales on apparatus	31
Formation of precipitates	30
For small demonstration equipment	30

Q. 3. You have now been exposed to two methods of using TV in instruction in chemistry: (a) the televising of lecture-demonstrations to small TV classrooms last semester, (b) the televising of demonstrations in the large auditorium this semester. Which use do you prefer?

Response	*Frequency*
No difference	22
Last semester's use better	128
This semester's use better	185
Did not have chemistry last semester on TV	63

Most frequent comments:

(a) Those who liked *last* semester's use of TV (in small receiving rooms):	
Fewer distractions in TV rooms	32
Could see and hear better in TV rooms	22
More comfortable in TV rooms	21
Not as crowded	12
Prefer TV room to rear of auditorium	12
(b) Those who liked *this* semester's use better (in large auditorium)	
Could see color	65
Advantage of live situations plus TV close-ups	34
Easier to copy from blackboard	27
Prefer lecture room	26
More apt to pay attention	15
Have real experiment before you	12

Q. 4. What suggestions do you have for making more effective use of TV in chemistry courses?

Most frequent comment	*Frequency*
Use color TV	93
Return to last semester's use (TV in small rooms)	36
Better camera coverage	21
Allow students free choice for TV or non-TV	11

It is clear that lack of color is the largest handicap confronting the use of TV in chemistry, that TV as a demonstration magnifier was most useful for small apparatus (of which only a few instances occurred in this course), and most helpful for those toward the rear of the room.

Most observers noticed that the students generally tended to look at the actual demonstration except when it was difficult to see what was happening. In these instances they looked at the TV receivers.

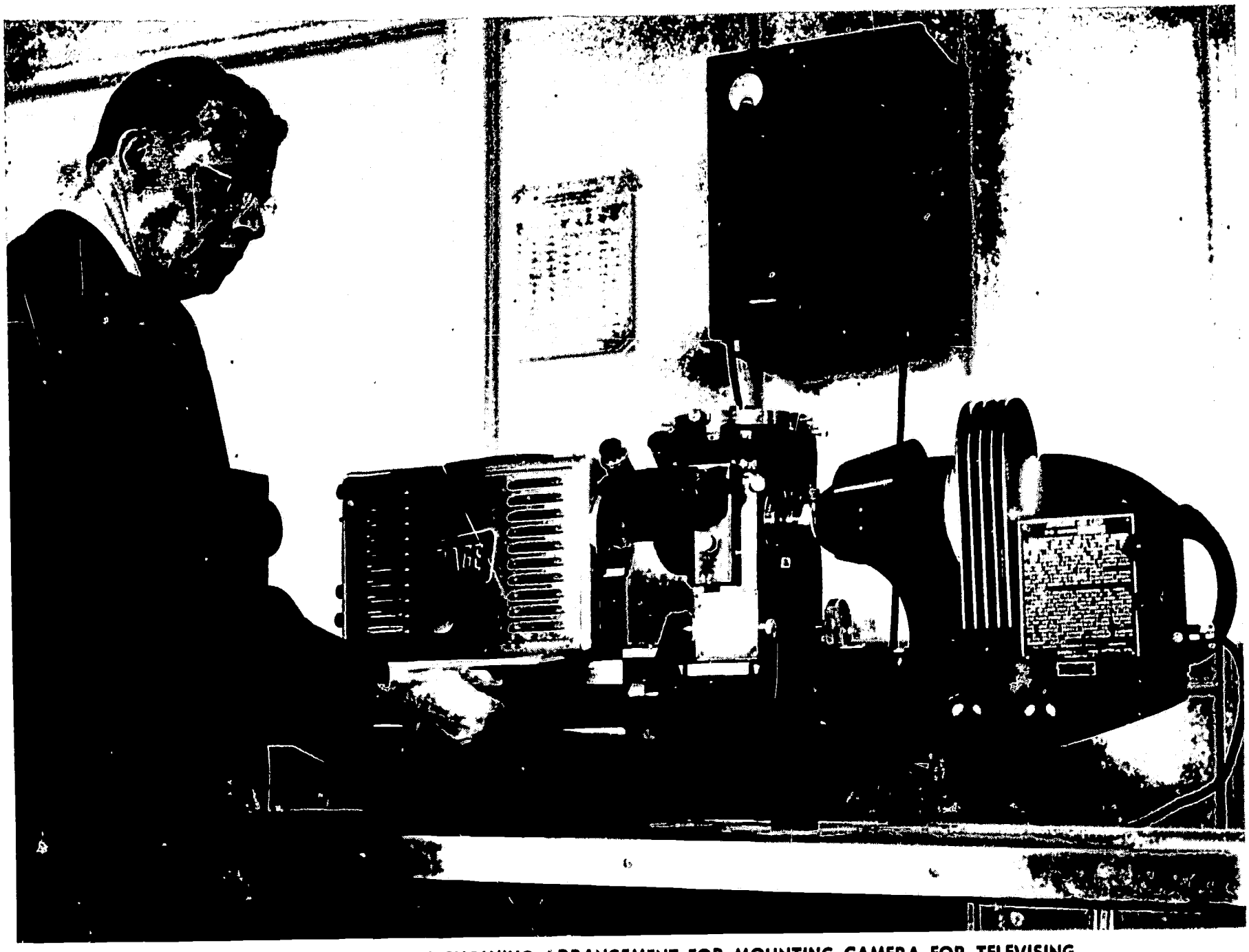


FIGURE 7. METALLOGRAPH SHOWING ARRANGEMENT FOR MOUNTING CAMERA FOR TELEVISING MAGNIFIED METALLIC SPECIMENS

Engineering Courses

Another demonstration magnifier system was installed in an auditorium (175 seats) in the electrical engineering building. In this application a simple industrial camera (Dage model 60B) with a monitor for the instructor and four 24" receivers for the students was tested. Simple floodlights were used for illumination. This was used for three different courses: First Semester Introductory Electrical Engineering, Second Semester Introductory Electrical Engineering, and Introduction to Engineering.

The instructor in the First Semester Introductory Electrical Engineering course made considerable use of models and small meters and an oscilloscope. He preferred to control the camera himself. Accordingly, the camera was mounted on a remote-controlled pan and tilt mechanism, and, by means of two toggle switches, the instructor could direct the camera. This worked fairly satisfactorily as long as the instructor located all demonstrations in the same plane of focus. Thus, it was possible for students to see meter readings and oscilloscope traces quite clearly on the TV screens.

However, a need was found for making lens changes to provide closer views on occasion and for remote control of focus to accommodate objects at various distances. Accordingly, a completely remote controlled servo unit was obtained. This provided a control console for the instructor alongside the demonstration table, which permitted adjustment of the TV camera's electrical controls, change of lenses, focus, and pan and tilt. In addition, the camera could be preset at three different positions, and would assume either position merely by the instructor's pressing a button.

This system was used for about half a semester. The instructor seemed fairly well satisfied with it although the operation imposed a considerable burden on him in addition to that of instruction. Also, some observers noted that the camera did not always frame up the subject as well as might be desired, and that the focus frequently needed fine adjustments.

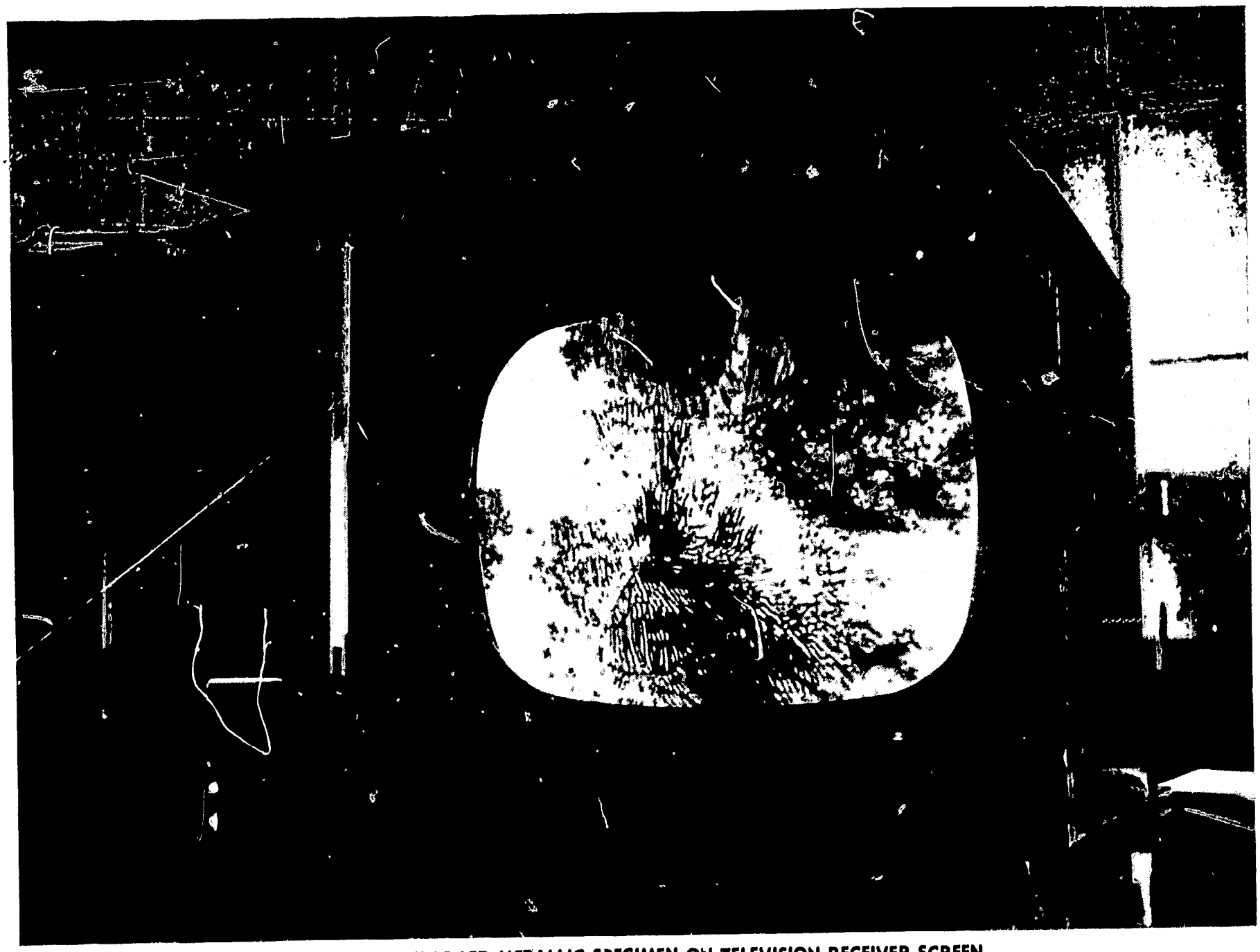


FIGURE 8. ENLARGED METALLIC SPECIMEN ON TELEVISION RECEIVER SCREEN

For a period toward the end of the semester the instructor did not use the remote control unit but arranged for a student to operate the camera. This seemed to be the most satisfactory arrangement at that stage of development.

This latter procedure was continued by another instructor who taught Second Semester Introductory Electrical Engineering during the Spring Semester 1957. This instructor made extensive use of small schematic diagrams and tables with considerable success. On one occasion also he arranged a televised presentation of the operation of the University's analog computer for the benefit of his class. It would have been impossible for his large group to have had this experience during one class session without television.

This simple TV system (value $2,500) was also used by the instructor in Introduction to Engineering in the same auditorium for teaching students how to use the slide rule. A large slide rule was televised, and students manipulated their own rules. This proved to be a particularly successful presentation.

Summary. The demonstration magnifier use of television appears to be appropriate for use in auditoriums for courses that involve demonstrations of equipment or apparatus. It makes possible the efficient use of auditoriums by permitting an increase of class size. For example, in General Chemistry using such a system, classes were increased in size from 125-150 to 250-300. In First and Second Semester Introductory Electrical Engineering and Introduction to Education the classes were increased from 30-35 to 150-175.

Generally a relatively low-cost but flexible TV camera such as the Dage model 101 with several lenses on a turret, side focus and an electronic viewfinder, operated by a student, seems to be the most satisfactory arrangement. Such a system, including six receivers and lighting, should not cost more than $3,500.

Additional Applications of Television

Metallurgy

Television has been used extensively at Penn State in metallurgy courses in conjunction with the metallograph (metallurgical microscope).

In several advanced courses it is necessary for students to be familiar with the structure and characteristics of a variety of metals prepared under different specifications. The usual procedure was to prepare polished and etched specimens and to have students examine them on the metallograph. This could be done by having each student take his turn at looking in the metallograph, a time consuming procedure. Since the metallograph is equipped with a camera having a ground glass focusing screen, attempts were made to project an image onto this screen for viewing by small groups of students. In a darkened room it was possible for perhaps six or eight students to obtain a view, but they had to be crowded into a small space directly to the rear of the projection screen.

It was thought that the use of a television camera would facilitate this instruction. Accordingly a small Dage model 101 camera was used in conjunction with the metallograph. The lens was removed from the TV camera and a short metal tube was substituted. The camera was mounted on the microscope bed in such a way that the projection eyepiece of the microscope fitted over the tube so as to exclude extraneous light. An image from the microscope was then focused on the light-sensitive face of the vidicon tube. The resulting television picture was fed into a modified 24" television receiver through a small video amplifier. Pictures of great magnification and of excellent contrast and resolution were obtained. It was possible with one receiver to have a group of 15 to 20 students observe each specimen simultaneously. The instructor could point out characteristics of the specimens and rotate them on the metallograph stage so that various areas could be examined. Furthermore, this could be done in a normally lighted room so that students could make sketches if they so desired. The lack of color did not appear to be a serious obstacle. Specimens could also be presented for the purpose of testing students' abilities to identify and describe them.

Tests were made with two sources of illumination on the microscope, a ribbon filament incandescent lamp and a carbon arc light. Both were satisfactory. As is always the case in microscopy, careful alignment of the light source with the optical system was found to be essential.

Speech

The Speech Department during the Spring Semester 1957 decided to use a small television system for the remote observation of examples of teaching either by experienced professors or by graduate assistants. This remote observation was to be used in connection with an advanced course in the teaching of speech.

A typical classroom having 40 seats was selected. Two internal reflector photofloods were installed together with two small fluorescent units to light the front of the classroom. At the rear of the room a Dage model 60 industrial type camera with a 3" lens was mounted in such a way as to obtain a good view of the front of the room. A desk microphone and amplifier were also provided. The signals were fed across the hall to an adjacent seminar room equipped with a 24" TV receiver. The electrical controls for the TV camera were also located in this room. It was possible at any time to turn on the camera to observe teaching demonstrations and for the instructor and students to discuss what they were observing without interfering unduly with the classroom situation.

Archeology

In Archeology many small artifacts are regularly shown to students. It has been the practice in the past for the professor to hold these up before the group or to pass them around from student to student. Neither of these procedures was particularly satisfactory. Accordingly, several trials were made using television to show close-up views of artifacts such as arrowheads or fragments of pottery. In addition it was possible to show small photographs out of books. This arrangement was considered to be entirely satisfactory, and plans have been made to use a television system regularly for one period a week during the fall of 1957.

Remedial Reading

The closed-circuit television system in the Sparks Building has been used regularly during the past two summers by the professor who instructs teachers in techniques for teaching children to read, or in remedying poor reading habits.

The procedure used involved the presentation from a small originating room of demonstrations by the instructor or another experienced teacher. In these demonstrations the teacher worked either with an individual child who was having reading difficulties, or with a small group of five or six children who were learning to read.

After the first few minutes the children appeared to be unaware of the presence of the television cameras, and it was possible to secure excellent close-up pictures of the children and the reading materials, as well as to hear what they were saying or reading. This was televised to teachers located in adjoining television receiving rooms.

Teaching Speed Writing

During the summer of 1956 a project was conducted for a graduate student's thesis[1] which involved the teaching of speed writing (abbreviated longhand) over closed-circuit television. The project was limited to about six sessions, but even in that short period, considerable increases in writing speed were obtained as compared to the speed with which students could take dictation at the start of the experiment. The success of this project suggests possibilities of teaching speed writing on a large scale either over open or closed-circuit television. This is a skill which would be valuable to many people.

Televising Lectures to Overflow Audiences

On several occasions it has been possible by means of closed-circuit television to accommodate overflow audiences at public lectures on the campus. On one occasion a lecture

1 Houtz, Mary Patricia. The effectiveness of closed-circuit television in the teaching of the principles of an alphabetic shorthand system, M.S. thesis, The Pennsylvania State University, June 1957.

FIGURE 9. ARRANGEMENT OF ORIGINATING ROOM FOR PRESENTATION OF EXPERIMENTAL COURSE IN SPEEDWRITING

on the Piltdown Man Hoax was scheduled in an auditorium seating 400 people. The hall was filled well before starting time, and it was possible to accommodate an additional 600 people in television receiving rooms. The lecture was televised from the auditorium and the slides used by the speaker were televised with quite satisfactory results. The use of such a system is quite feasible for expanding limited auditorium facilities.

Adaptation of Buildings for Closed-Circuit TV Operations

At Penn State, as in most other institutions, television systems for instructional uses have been fitted into existing buildings. This has necessitated modifications of the physical facilities for origination, transmission and reception of televised instruction.

Originating Rooms

Where a large auditorium has been used for originating courses, the principal modification to the room has been the installation of lighting. At Penn State incandescent spotlights and floodlights have been used to achieve an even illumination of from 200 to 250 footcandles[1] across the area used for the presentation of instruction. Side and back lighting was necessary in addition to front light to achieve a picture showing good separation of objects. These requirements have necessitated the suspension of lights from the ceiling and the supply of additional electric power.

Sixty to 80 amperes of current were used in each of the large originating rooms. In addition, an adequate supply of power was necessary to operate a professional vidicon system with film chain and audio system. This supply was in

1 As read on a Norwood incident lightmeter.

the region of 50 to 60 amperes. A single camera of the Dage 101 type may be operated from a regular 15-20 ampere outlet. Experience has shown that voltage fluctuations are likely to be a serious problem in most installations. At Penn State it has been necessary to operate the camera equipment from automatic voltage regulators.

Generally speaking, the acoustical characteristics of large auditoriums have not presented serious problems. In small originating rooms, in addition to providing power for lighting, and the installation of a pipe grid near the ceiling to support lighting units, acoustical treatment of the walls and ceilings is necessary. This should be in the form of drapes and/or acoustical tile. Some additional ventilation will be necessary in both the control room and the originating room where professional type of equipment is used. The TV power supplies develop a considerable amount of heat as do the lighting units. Air conditioning would be ideal, but if this is not possible some other adequate means of extracting hot air should be provided.

Connections with Receiving Rooms

It is necessary to install coaxial cables and possibly audio and two-way communication cables, depending on the type of distribution system used, (see Chapter 5) to connect the originating rooms with the various receiving rooms. In existing buildings these cables can often be installed in hollow walls or ceilings or in existing ducts. However, in older buildings where there are no such provisions it may be necessary to run a conduit along hallways to carry the necessary cables.

In new buildings provisions should be made for the future installation of television cables.

Receiving Rooms

At Penn State regular classrooms were used as television receiving rooms with practically no modification. However the existing rooms are far from ideal even for regular classroom instruction. They have poor acoustical qualities, the seats are fixed in rows, and window shades are inadequate for control of external light. Furthermore, ventilation is inadequate especially in winter when the windows must be closed. However, in spite of these unfavorable conditions, reasonably acceptable results have been obtained.

Provisions for TV in New Buildings

It was possible to have some provisions made in a new classroom building, which is just now being completed at Penn State, for the future installation of closed-circuit television.

Two originating rooms with adjacent control rooms were built in such a way that they could be used as classrooms until such time as they might be used for television. These rooms are of a minimum but useable size, the originating rooms being 24′ x 20′ and the control rooms 15′ x 20′. One originating room can be doubled in size by the removal of a special wall between it and the next classroom. Verticle conduits have been provided in the walls for additional electric power when it is needed.

All the hallway ceilings in the building have been furred down about 3′ to provide a crawl space for coaxial cables or other utilities. There are also additional verticle conduits in the building and conduits between the crawl space and the classrooms for installation of coaxial cables. This rather simple arrangement makes possible connections between any rooms in the building.

The classrooms also have desirable characteristics as follows:

(1) All ceilings have acoustical tile.

(2) All rooms have mechanical ventilation.

(3) Venetian blinds running in channels provide for control of external light.

(4) Fluorescent lighting units are mounted against the ceilings and will minimize reflections on the faces of television receivers. The units are on several circuits so that the lighting level can be varied if necessary.

(5) Moveable chairs have been provided which will permit flexible seating arrangements.

(6) All rooms have power outlets at convenient points for television receivers.

(7) The rooms are painted in pastel shades, rather than in somber colors.

Similar considerations are being taken into account in the planning of another future classroom building.

It would appear that the time is approaching when it will be appropriate to make a study in order to determine the ideal characteristics of classrooms for televised instruction. Among other characteristics to be considered should be the following: The shape of the room, its size, location and housing of TV receivers, seating arrangements, and the availability of supplementary resourse materials. The question of whether or not classrooms need windows deserves serious consideration.

General Comments on Adaptation of Courses to Television

As was reported in the previous chapter of this report, comparisons were made in the General Psychology course in the Spring Semester 1957 between the performance of students who received this highly visualized adapted presentation and that of a group receiving a traditional lecture-blackboard presentation, also over television. It will be recalled that no significant differences in the achievement of students were measured.

Similarly, in the Air Science course offered to cadets in the Reserve Officers Training Corps, strenuous efforts were made to adapt the course so as to make appropriate use of television by using models, graphic materials, panels and films. For one block of instruction in which two methods of presentation

were compared, (the adapted presentation and the traditional lecture-blackboard method) students' achievement scores revealed a small but significant difference in favor of the traditional method of instruction.

These findings suggest several hypotheses for future experiments:

(1) Students need to learn how to learn from visualized methods of presentation with which they are not familiar.

(2) The types of verbal tests generally used to assess achievement, even though they are judged to be very good ones, may not be measuring some of the kinds of learning that result from, say, demonstrations, or other visual presentations. In other words, verbal tests tend to be biased in favor of verbal presentations. On the other hand, it can be argued that in these introductory courses, familiarity with concepts and principles and their application is the main concern, not actual on-the-job performance such as might be required in administering an intelligence test, for instance, a skill that would be learned in more advanced courses.

(3) A third hypothesis is that *methods* of instruction are relatively unimportant. The important factors are the student's intelligence, his level of aspiration, and his willingness to learn. Two other potent factors are likely to be (a) repetition of the presentation of important concepts, and (b) logical progression from one topic to the next. There is also some evidence that the personality and experience of the teacher are important factors. Apparently some teachers are more effective than others in stimulating students to learn.

(4) Finally, it is possible that much more radical changes in course presentations will have to be devised before differences will emerge when comparisons are made with traditional methods.

It has not yet been possible to design and develop a course completely for television presentation. In most cases varying degrees of adaptation have been made. However, a move in the direction of planning a special course for TV presentation occurred during the summer of 1956 when the University was invited by the Information and Education Division of the Department of Defense to make kinescope recordings of sixteen half-hour lessons in General Psychology and eighteen half-hour lessons in General Chemistry. These film recordings are to be used in conjunction with the correspondence courses and study materials offered by the U. S. Armed Forces Institute.

During that summer period, the professor who undertook the course in General Psychology spent much time in conjunction with the TV Project staff on the development of special charts and demonstrations for the kinescope series. During the fall and spring of 1956-57 it was possible for the professor to use many of these materials in his course over television, along with films and guest speakers.

Summary

In this section a wide range of uses of closed-circuit television in a university has been described. Likewise efforts to adapt courses and television each to the other have been reviewed. This work demonstrates and suggests possibilities for using instructional television under a great variety of conditions and for many purposes. Also the fact is emphasized that the problems of making adaptations are many and some are difficult.

Adequate quantitative criteria are not available for determining the degrees of appropriateness of television for teachers and students as well as for courses, specific educational functions, and physical plant conditions. The conclusion that television is appropriate for many educational functions is based mainly on experience and judgment.

It is also clear that by means of many kinds of adaptations the appropriateness factor can be improved. Finally, it is important to observe that evaluations of televised instruction should recognize the fact that many specific conditions and arrangements must be considered. A great many factors are involved both for television and for teaching and learning.

4—Studies of Acceptance

Introductory Statement

Closed-circuit television was introduced, developed and adapted to instructional programs at Penn State during the period from the academic year 1953-1954 through 1956-1957. About 15,000 students registered in different courses, have had presented to them all or parts of courses over television. Approximately 45 teachers have at some time taught regularly over television and many others have used a TV system occasionally. Both students and faculty members have discussed issues about the merits and limitations, the advantages and disadvantages, and the desirability and undesirability of televising regular classroom instruction. These discussions were encouraged at Penn State. In order to provide information which would give substance to discussions, frequent reports of the TV Project were made and widely distributed to the faculties of the University. Student reporters were assisted in preparing articles for the student newspaper, the *Daily Collegian.* All who expressed interest were given encouragement and were provided with opportunities for making direct observation of televised instruction. Thus, acceptance of instructional television is having a fair and realistic test.

Since biases as to the merits of televising instruction are often strong, the "fair test" concept is important. A guiding principle at Penn State is that instructional television should be accepted or rejected on the basis of merit. The fair test concept opposes promotionalism, encourages the collection and evaluation of reliable evidence, and requires the correction of faculty observations and the reduction of biased and prejudiced judgments. Provisions for a fair test of an instructional procedure such as television are not easily arranged because of the highly personal character of teaching and of learning. Furthermore, the problem of acceptance of instructional television is not a simple homogeneous problem. Opinions and judgments can be found in a wide range on many different scales. Some can be generalized on a scale of *acceptance, neutral,* and *rejection.* This scale roughly reflects a general preference and tendency to action on the part of individuals whose behavior is conditioned by many specific factors.

Such questions arise as the following: For what kinds of students and teachers is television acceptable? For what courses or parts of courses and for what methods or specific functions of instruction is television acceptable? To what degree of use is television acceptable? Clearly, acceptability of television relates to the perceived advantages or disadvantages both to faculty members and students, and these are judged relative to the merits and limitations of many other alternatives. For example, it appears that the continuing, and perhaps increasing, acceptance of televised instruction by students at Penn State relates to the dependable excellence of the teaching found in TV sections of courses. Students now know, or are learning, that when they register for a TV section or a course on television that they will have an instructor who is among the best available. They have a good chance of being taught by a superior teacher. Likewise the attitudes of teachers are conditioned by what they find to be the relative merits of using television, compared with other possible procedures. Different teachers like or dislike very different characteristics. Some like the ease with which visual materials can be presented. Others see this as no advantage for them. Some teachers respond favorably to having themselves and their work widely observed; others react negatively. Thus, general acceptance is a composite of many specific elements and conditions.

The basic question of whether there is an important relationship between attitudes of students toward televised instruction and their academic achievement has been investigated in several courses. A similar question is whether there is an important relation between the attitudes of teachers toward televised instruction and the effectiveness of their teaching. Since the central objectives of teaching and learning are concerned with the academic achievements of students, this question should be answered in future research.

Faculty Attitudes toward Televised Instruction at Penn State

Previous studies at Penn State and other institutions have indicated that faculty attitudes are of critical importance for the introduction, development and use of TV systems for course instruction. Therefore, as the Project continued, special efforts were made to assess faculty opinions and attitudes, and to determine, if possible, the changes which occurred from year to year. A systematic survey was conducted in 1955-1956 and the study was repeated as closely as possible in 1956-1957. It is important to report these surveys in detail.

A systematic attitude and opinion questionnaire of the usual type was prepared, revised and pre-tested by Lester A. Guest, a specialist in public opinion survey techniques, for gathering information about faculty attitudes towards televised instruction. He also supervised the survey project and established procedures, independently of the TV Project staff, for securing anonymity of replies and for avoiding any biases which might be introduced by those associated with the Project.

General procedures used were the following: Each year a sample of over 200 names was drawn from among the instructors of the University faculty. Excluded from the sample were all administrators, research directors, research men who did not teach, those who had taught or were teaching over television, the Project staff and members of the

Psychology Department faculty who were used as a test population in developing the questionnaire.

Completed questionnaires were returned by 177 faculty members in 1955-1956 and 140 in 1956-1957. The last year 27 were returned unanswered; most of these had been sent to extension workers and service people who were not well informed concerning on-campus academic activities. Responses exceeded general averages of responses received from sampling opinions by mail.

The questionnaires were sent out by and returned to men who were not identified with the TV Project. Results were tabulated by research assistants of the Department of Psychology.

The same questionnaire with minor modifications was later completed by 15 TV teachers who were active on the Project during the spring of 1956-1957. These instructors had direct, and some of them extensive, experience with instructional television. They had given much thought to many relevant considerations. Therefore, even though the number of cases is small, it is believed to be worthwhile to include results in terms of percentages for the TV instructors in some of the following tables.

Responses to the majority of the questions are given below. To conserve space a few questions of lesser importance have been omitted.

Question 1: Information was sought on the size of classes that were taught by the respondents, on the assumption that those who taught large classes might perceive TV differently from those who taught small classes. The proportion of classes of varying sizes was also of interest. It was learned that an average of only 20 percent of the teachers for each of the two years taught classes of more than 50 students and of these only 7 percent each year taught classes with more than 100 students.

Question 2: "What is your opinion about student enrollment pressures in your department now?"

An average for both years of about 15 percent of the sample believed that enrollment would "increase to where new techniques must be developed" to take care of the increasing enrollment of students. An average of 42 percent checked that enrollment may be "increased but can be handled by present methods." An average of 36 percent believed that enrollment pressure is "not a particular problem."

Question 3: "If, because of the pressure of student enrollment, it should become necessary either to teach some of your courses by closed-circuit television *or* to teach large sections, that is, 150 or more per class, which of these alternatives would you prefer?" Assistants and other factors were to be considered equal in the two situations. Table 62 presents the percentage distribution of replies.

The sample of non-TV teachers each year preferred large classes to televised classes. The results reflect gains in preference for both television and large classes with reduction in the number of individuals checking no difference. On the other hand, teachers who have had experience with television overwhelmingly prefer that method over large classes.

TABLE 62

Faculty Preferences for Television or Direct Instruction in Large Classes

Response	*1955-1956* *Non-TV Teachers* *N = 177*	*1956-1957* *Non-TV Teachers* *N = 140*	*1956-1957* *TV Teachers* *N = 15*
Television	28%	34%	74%
Large Class	37%	41%	12%
No Difference	27%	17%	7%
No Answer	6%	6%	7%
Misc. Comment	1%	1%	
Don't Know	1%	1%	

Question 4: Information was sought about the amount of direct observation of televised instruction by the sample of teachers. Table 63 gives the results.

TABLE 63

Amount of Faculty Observation of Televised Classes

Response	*1955-1956* *Non-TV Teachers* *N = 177*	*1956-1957* *Non-TV Teachers* *N = 140*	*1956-1957* *TV Teachers* *N = 15*
No classes observed	73%	61%	27%
Less than a period	14%	14%	20%
One complete period	5%	10%	0%
Two periods or more	8%	15%	54%

The majority of the sample of non-TV teachers have not, after three years, directly observed televised instruction but it would seem that slowly more and more faculty members are doing so. The fact that by 1956-1957, 39 percent had made some observations is encouraging since the visiting of classrooms is extremely limited at Penn State. Forty-seven percent of the TV instructors had not observed any other teleclasses or had only observed for less than a period; fifty-four percent had observed two or more periods.

Question 5: Those who had observed televised instruction to any extent were asked to express opinions on the quality of

instruction as compared with the same teacher instructing in a regular classroom. Table 64 gives the results.

TABLE 64

FACULTY OPINIONS ON QUALITY OF TV INSTRUCTION IN COMPARISON WITH DIRECT INSTRUCTION

Response	*1955-1956* *Non-TV Teachers* *N = 48*	*1956-1957* *Non-TV Teachers* *N = 55*	*TV Teachers* *N = 10*
TV Better	10%	22%	61%
TV Same	33%	38%	23%
TV Worse	52%	38%	8%
No Answer	3%	0%	8%
Don't Know	2%	2%	0%

The general improvement of TV instruction through adaptations and developments may be reflected in the increased percentage who checked the items *better* and *the same* and reduction in judgments of *worse* in 1956-1957 compared with the previous year.

Faculty members may accept and approve TV for others but not for themselves. By means of the following question, attempts were made to sample personal feelings among teachers who had not taught on TV toward taking part in experimentation.

Question 6: "How would you feel personally about experimenting with one or more of your courses on closed-circuit television if the sections were large?"

TABLE 65

FACULTY WILLINGNESS TO EXPERIMENT WITH TV FOR THEIR OWN COURSES

Response	*1955-1956* *Non-TV Teachers* *N = 177*	*1956-1957* *Non-TV Teachers* *N = 140*
Like it very much	16%	14%
Probably like it	27%	31%
No special feeling	27%	23%
Probably dislike it	21%	23%
Dislike it very much	6%	8%
Miscellaneous	1%	0%
No answer	2%	1%

One possible interpretation of this tabulation is that 70 percent of the faculty members sampled in the first year and 68 percent in the second year would not have strong reservations to experimenting *personally* with their own courses over television if the enrollment were large. These might constitute a potential pool of television instructors should the need for them arise. The most favorable reserve pool might well be the 16 percent and 14 percent in each year who indicated they would like very much to experiment with television. When this number is added to those on the faculty who have taught or are teaching over television it can be concluded that Penn State has an adequate number of faculty members for staffing those courses which might be appropriately scheduled on television. Whether or not these favorably disposed teachers have the necessary characteristics to be successful TV instructors and are employed in areas of the curricula where television is or will be needed, are different considerations.

Of the fifteen instructors who responded from among those who actually taught on TV, fifty-three percent *liked TV teaching,* 27 percent *liked it somewhat,* seven percent *didn't care,* seven percent *disliked it somewhat* and seven percent *disliked it very much.*

A similar question dealt with regular use of television as distinguished from the experimental use. The following question was asked of teachers who had not taught on TV:

Question 7: "How would you feel personally about *regularly teaching* one or more of your courses by closed-circuit television if the sections (class) were large?" Results are given in Table 66.

TABLE 66

FACULTY REACTION TO TEACHING THEIR OWN COURSES REGULARLY OVER TV

Response	*1955-1956* *Non-TV Teachers* *N = 177*	*1956-1957* *Non-TV Teachers* *N = 140*
Like it very much	8%	6%
Probably like it but reserve judgment	32%	35%
Don't care one way or the other	11%	12%
Probably dislike it but reserve judgment	37%	33%
Dislike it very much	10%	11%
Miscellaneous	1%	1%
No answer	2%	2%
Don't know	1%	0%

The results indicate that slightly more than 50 percent of the faculty surveyed would have no strong objection to teaching their own courses regularly over television if the enrollments were large.

Comparison of the replies on the question of *experimentation* with the one on *regular use* shows a more favorable gen-

TABLE 67

Reasons Given by Non-TV Teachers for Both Unfavorable and Favorable Reactions Toward Teaching Their Own Courses

Limitations	*1955-1956*	*1956-1957*	*Advantages*	*1955-1956*	*1956-1957*
Lack of contact and individual attention	19%	26%	Better instruction for more students	5%	6%
No feedback	15%	17%	Like to try new methods	5%	6%
Impersonal	5%	14%	Conducive to better preparation	2%	6%
No student questions	14%	13%	TV good education-communication medium	0%	6%
Not applicable to course	16%	13%	More variable situation with visual aids	3%	5%
Limit teaching techniques	2%	7%	Teach greater number	3%	3%
Change teaching methods	0%	4%	Supplement present methods	0%	3%
Anonymity of students	1%	3%	Offers a challenge	1%	2%
Lose personal relationship	2%	3%	Eliminates large classes	4%	1%
No color	1%	2%	Close-ups	3%	1%
Loss of teacher personality	1%	1%	Hearing (better)	2%	1%
Limited blackboard vision	1%	1%	Provide less detail work (reports & papers)	1%	1%
Less student attention	2%	1%	Fewer student distractions	1%	1%
Too much preparation required	1%	1%	Uniformity of instruction	1%	1%
Discipline problem	1%	1%	Student preference for TV	0%	1%
No rapport	1%	1%	Reduce teacher shortages	0%	1%
Damage higher education	1%	1%	Use of two-way TV	0%	1%
Disturbed by mechanics	1%	1%	Save time and expense	1%	0%
Feel self-conscious	1%	1%	Easier to teach	1%	0%
Prefer movies	0%	1%	Allow less abstraction	1%	0%
Non-permanent learning by TV	0%	1%	Miscellaneous	0%	1%
Favorable experiences with large classes directly taught	0%	1%			
Detrimental to professors' status	0%	1%			
Poor student attitudes to TV	0%	1%			
Screens too small	1%	0%			
Extra training necessary	1%	0%			
See only pictures not actuality	1%	0%			
Unsure of obtaining departmental assistance for TV	0%	1%			

eral attitute to the former than the latter. The consistency of results from year to year should be noted.

In order to get statements which described in fairly specific terms the beliefs of faculty members who had not taught on TV about the limitations and advantages of televised instruction, the following open-ended question was asked:

Question 8: "Although you probably could discuss this at great length, could you briefly list the reasons you feel as indicated in Question 7?" The results are given in Table 67.

The tabulation indicates that more comments were produced which could be classed as limitations than as advantages. The item content suggests that the main reservation relates to lack of student-teacher interactions when TV is used. More comments were written the second year than the first.

The replies to a question on reactions of TV instructors to teaching over television are given below.

Question 9: "Now that you have directly participated in the TV Program, how do you feel about using TV for instructional purposes?"

	TV Teachers N = 15
Excellent technique in general	54%
Pretty good technique in general	26%
Undecided	0%
Not convinced, desirable in general	20%

Question 12: "Do you think that using TV as an instructional device for teaching large classes is or will be enough of a threat in any way (that is, fewer jobs for teachers, violation of class privacy, etc.) so that the teaching profession in general would be opposed on these bases alone?" The results are given in Table 68.

The majority of the sample did not believe televised instruction to be a threat to the teaching profession. From the first year to the next, opinions supporting this point of view increased. Fewer individuals checked the *don't know* item the second year. They were also asked to give their impression of the reactions of other faculty members to the

possible "threat" of television. Answers given were very similar to those listed in Table 68. Those who teach over television at Penn State did not feel threatened.

TABLE 68

Reactions of Faculty as to Whether TV Constitutes a Threat to the Teaching Profession

Response	*1955-1956 Non-TV Teachers N = 177*	*1956-1957 Non-TV Teachers N = 140*	*1956-1957 TV Teachers N = 15*
Yes	7%	6%	0%
No	70%	81%	94%
Don't Know	23%	13%	6%

Question 14: "To what degree would you like to see TV instruction expanded for large multiple-section classes which you might or might not teach if you were assured that you would have more time to pursue your own research or other professional or scholarly activities?" This question was asked of teachers who had not taught over TV. Results are given in Table 69.

TABLE 69

Faculty Reaction to Expanding TV Instruction

Response	*1955-1956 Non-TV Teachers N = 177*	*1956-1957 Non-TV Teachers N = 140*
Expand a great deal	11%	15%
Expand to some degree	28%	33%
Expand not very much	15%	16%
Not at all	14%	12%
Still undecided	28%	19%
Miscellaneous	2%	3%
No answer	2%	2%

In 1955-1956 fifty four percent and in 1956-1957 sixty four percent of the faculty appeared to be favorable toward some degreed of expansion of the uses of TV systems at Penn State for large multiple-section courses. Favorableness toward expansion represents a more positive position than the mere acceptance of the present scope of operation.

Question 16: "Assuming the correctness of the prediction that the University will have a substantial increase in enrollment, what would be your preference for methods of handling the increase?" This question was asked of those teachers who had not taught over TV. The results are given in Table 70.

TABLE 70

Faculty Preference for Methods of Teaching Increased Numbers of Students

Response	*1955-1956 Non-TV Teachers N = 177*	*1956-1957 Non-TV Teachers N = 140*
Increase class size; same class load	11%	13%
Keep classes same size; increase class load	9%	7%
Use TV, faculty teaching hours as now	20%	24%
Keep class size same; use more inexperienced teachers	9%	12%
Other write-in suggestions	51%	43%
No answer	0%	1%

The response *use TV, faculty teaching hours as now* was checked most frequently in both years. Additional *write-*

TABLE 71

Faculty Attitudes toward Permanence of TV at Penn State

Response	*1955-1956 Non-TV Teachers N = 177*	*1956-1957 Non-TV Teachers N = 140*	*1956-1957 TV Teachers N = 15*
1. TV to stay at Penn State, even if research results indicate TV inferior to conventional classroom instruction.	3%	7%	15%
2. TV to stay at Penn State, if no great differences result from use as an instructional device.	39%	45%	46%
3. TV to stay at Penn State, only if research results specifically indicate its superiority over classroom teaching.	34%	28%	0%
4. TV to stay at Penn State; makes no difference how research comes out.	7%	14%	27%
5. Makes no difference how research comes out—TV will not be used long as instructional device.	1%	1%	0%
6. Miscellaneous	2%	1%	0%
7. No answer	11%	1%	12%
8. Don't know	3%	3%	0%

in suggestions emphasized that increases in the size of the faculty and increases in salaries would be the most desirable solution to increased enrollment.

Question 18: "Which of the following statements best expresses your attitude?" See Table 71.

These are reasonable replies. Those responsible for the TV Project have taken a firm position that demonstrated decrement of instructional quality as a result of television will not be acceptable. It was probably difficult for respondents to discriminate between the second and third responses. Also, what was meant by "superiority" in item three could not be defined. Some phases of "superiority" may relate to very practical questions. Item four provided for the opinion sometimes expressed that TV had been introduced and would be continued as a result of administrative fiat, regardless of results. The expansion and continuation of the TV Project probably influenced the increase from 7 percent to 14 percent from one year to the next for item four among non-TV teachers.

Question 19: "Using TV for instruction, the quality of a college education, as you conceive it, will:" See Table 72.

TABLE 72

FACULTY ATTITUDES TOWARD EFFECT OF TV ON QUALITY OF COLLEGE EDUCATION

Response	*1955-1956* *Non-TV Teachers N = 177*	*1956-1957* *Non-TV Teachers N = 140*	*1956-1957* *TV Teachers N = 15*
Suffer a great deal	23%	25%	15%
Suffer a little	41%	32%	31%
Not suffer, not gain	14%	19%	15%
Be enhanced some	14%	13%	31%
Be enhanced a great deal	1%	1%	8%
Miscellaneous	3%	4%	0%
No answer	2%	1%	0%
Don't know	2%	5%	0%

The samples of faculty members at Penn State were not yet convinced that TV instruction does not reduce the quality of education. It is not clear whether this question meant classroom instruction or the whole college education experience. It is impossible to state whether the use of TV itself or the associated idea of having large classes accounts for the distribution of responses.

Question 26: Those respondents who had discussed televised instruction with other faculty members were asked to estimate, "how the majority of teachers feel about it." The results are given in Table 73.

TABLE 73

FACULTY ESTIMATES OF THEIR COLLEAGUES' REACTIONS TO TV

Response	*1955-1956* *Non-TV Teachers N = 111*	*1956-1957* *Non-TV Teachers N = 106*	*1956-1957* *TV Teachers N = 15*
Very favorable	1%	1%	0%
Quite favorable	5%	5%	8%
On positive side	22%	18%	38%
Neutral	22%	20%	0%
Somewhat negative	33%	41%	46%
Quite negative	14%	11%	8%
Very antagonistic	3%	4%	0%

These results should be interpreted against the background information that a year had intervened and more discussion had occurred. Comparison of the two distributions of non-TV instructors showed a trend in a negative direction. These figures do not seem to coincide with many observations and reports that there is generally a slow positive drift of faculty attitudes toward TV.

Question 28: "For the courses that you might teach by TV, in order to achieve the same results you think you get now, would you anticipate that your own work for these courses would be": See Table 74.

TABLE 74

FACULTY ESTIMATES OF AMOUNT OF WORK REQUIRED TO TEACH COURSES ON TV

Response	*1955-1956* *Non-TV Teachers N = 177*	*1956-1957* *Non-TV Teachers N = 140*	*1956-1957* *TV Teachers N = 15*
TV Easier	6%	6%	13%
TV No different	20%	19%	7%
TV Harder	65%	67%	80%
Miscellaneous	2%	2%	0%
No answer	5%	4%	0%
Don't know	2%	2%	0%

The majority of the sample population estimated that teaching by television would be *harder* in order to achieve the same results. It is a fact that TV instruction is more demanding, especially when adjustments are being made by the instructor and his course is being adapted for television.

Question 31: "If the cost of sending a son or daughter to one of two universities were the same, and the universities were about equal in size and competencies of staff and faculties, but one taught most large elementary courses by television and the other did not, which would you like your son or daughter to attend?" The results are given in Table 75.

TABLE 75

FACULTY ATTITUDES TOWARD SENDING OWN CHILDREN TO COLLEGES WHERE MOST LARGE COURSES ARE TELEVISED

Response	*1955-1956* *Non-TV Teachers N = 177*	*1956-1957* *Non-TV Teachers N = 140*	*1956-1957* *TV Teachers N = 15*
TV institution	8%	18%	54%
Non-TV institution	59%	62%	15%
Makes no difference to me	29%	18%	23%
Miscellaneous	2%	0%	0%
No answer	1%	1%	8%
Don't know	1%	1%	0%

The majority of the non-TV sample said they would select the non-TV institution. There was a 10 percent increase during the year in those who would select the TV institution. However, 54 percent of TV instructors indicated they would select the TV institution. Answers to this question should be compared with those of the next question.

Question 32: "If you had a son or daughter attending college, would you prefer that the student take a course over TV from the best professor of a department, or settle for a lesser (but adequate) professor who met the students face-to-face in a classroom even if it was a large class?" The results are given in Table 76.

TABLE 76

FACULTY PREFERENCE FOR HAVING OWN CHILDREN INSTRUCTED BY BEST PROFESSOR OVER TV OR LESSER PROFESSOR BY DIRECT INSTRUCTION

Response	*1955-1956* *Non-TV Teachers N = 177*	*1956-1957* *Non-TV Teachers N = 140*	*1956-1957* *TV Teachers N = 15*
Best professor on TV	46%	58%	85%
Lesser professor in class	37%	26%	15%
Makes no difference to me	7%	8%	0%
Miscellaneous	3%	3%	0%
No answer	5%	1%	0%
Don't know	2%	4%	0%

Assuming that the best professors teach over television, the choice of these samples swung heavily toward TV and a gain of 11 percent was indicated over the previous year.

Finally, Question 25: The respondents each year were asked if they had discussed televised instruction with students. Thirty-four percent replied in the affirmative in 1955-1956 and 64 percent in 1956-1957.

Table 77 shows how respondents who had discussed TV with students thought the majority of students felt about it.

TABLE 77

FACULTY ESTIMATES OF STUDENTS' REACTIONS TO TV CLASSES

Response	*1955-1956* *Non-TV Teachers N = 60*	*1956-1957* *Non-TV Teachers N = 89*	*1956-1957* *TV Teachers N = 15*
Very favorable	0%	0%	0%
Quite favorable	0%	5%	7%
On positive side	20%	10%	46%
Neutral	23%	27%	20%
Somewhat negative	39%	40%	27%
Quite negative	15%	15%	0%
Very antagonistic	3%	3%	0%

The distributions for non-TV instructors are skewed in a negative direction.

These estimates of student opinion may be compared with a variety of measures of students' attitudes toward televised instruction which will be reported in detail in a following section.

These results seem to indicate a gradual slow rate of change in attitudes of faculty members, (a) toward a recognition that closed-circuit television has a justifiable place in a large university, (b) toward recognition of both the advantages and the limitations of instructional television and hence, (c) toward tentative acceptance of procedures for using TV appropriately as an instrument of instruction in large multiple-section classes. A need for more information to serve as a basis for sound judgments and attitudes of the faculty was indicated.

Observations of General Reactions and Attitudes of TV Instructors toward Televised Instruction

The most significant fact to be noted is that for three years there has been a gradual increase in the number of faculty members who have volunteered their courses or responded favorably to invitations to present their courses over television. This trend was certainly one realistic, practical and valid test of acceptance.

Within the groups of faculty members who have taught over television there was considerable variability of reactions

and attitudes toward the operation. For descriptive purposes these teachers may be classified into several categories:

Category 1. *The highly motivated and intensely involved instructors.* Instructors in this category have dismissed the question of whether or not they should use television. They are fully committed. The central concern for them was how to adapt their courses and television procedures in order to produce maximum effects on the academic achievements or behavior of their students. They were not merely cooperative with the Project staff but they took the initiative in seeking help from the staff in improving all aspects of their courses. Generally they did not seek personal advantages for themselves because they were teaching over television. The advantages they emphasized were those for improving their teaching in the interest of students in the face of increasing enrollments. They not only accepted television but they also accepted the rigorous demands of experimentation in their courses.

Category 2. *The conditionally committed instructors.* Television teachers in this category accepted the increased demands made on them provided there were compensating personal advantages such as reduced workloads of classes, increased personal and professional recognition and prospects of salary increases. With enough external encouragement they accepted the necessary responsibilities of TV teaching and cooperated to some extent in research and experimentation. Members of this group took much less initiative in adapting and improving their courses. Their interests were centered more in subject matter than in students and their academic progress. Generally they considered the job done when the TV presentations were over and they were reluctant to undertake out-of-class work to compensate for any inherent limitations of televised instruction. These instructors needed much encouragement from administrators and help from colleagues and assistants in the conduct of their TV courses.

Category 3. *The passively committed instructors.* These instructors usually taught some large classes. They agreed to schedule them for presentation over television. Ordinarily the lecture-blackboard method was used and highly developed. The courses were conducted in a conventional manner but over television, usually at first with students present and later without them. They did not take the initiative for changes, improvments and adaptations either of their course or of television procedures. Such changes when suggested were generally not followed. Since, with this type of instruction there were few or no additional demands made on the teachers compared with previous modes of teaching, instructors in this category were not very concerned with reduced hours of teaching or other advantages.

Category 4. *The uncommitted instructors.* These instructors, for many different reasons, adopted television as a temporary arrangement. They were willing to experiment for a semester or two and then wished to discontinue teaching over television. Some teachers in this category either because of low motivation, or because of limitations or characteristics of their teaching skills, did not make the grade over television. Some became defensive and were unfavorably aggressive about television as a teaching procedure. They resisted adaptations and usually did not adjust personally to the special and general demands of such teaching. For these instructors television seemed to accentuate limitations of teaching skills and abilities. Thus, they did not long survive the rigors of instructional television.

In summary, it is very clear that instructors included in categories 1 and 2, and occasionally those in category 3 constitute the dependable core of television instructors. The realistic problem is to find and provide opportunities for instructors described under category 1 and to develop and encourage as necessary those included under category 2. Scheduling of courses staffed by instructors described in category 3 should be based on necessity. The general problem of discovering, encouraging and developing superior and vitally interested television instructors is *supremely* important if this approach is to be used.

Student Attitudes toward Televised Instruction

Introductory Statement

Surveying student opinions and attitudes toward televised instruction has become a widespread standard procedure wherever TV projects are conducted. Such surveys have value as a general assessment of the acceptance of the procedures by students, as a means of permitting students to participate in the evaluation of TV, and as a way of collecting suggestions about improving TV operations and televised courses.

It may be noted that the same consideration is rarely shown for student opinions and attitudes about the use of *traditional* instructional methods. What are student attitudes and opinions relative to lectures, demonstrations, the instructor-controlled classes, 18-hour credit loads, the two semester annual schedule, the grading system, the increasing number and sizes of textbooks and a host of other elements of college education which touch closely their lives? More specifically, what would be the pattern of students' reactions? What percentage of a sample population would say: like, neutral, or dislike, for example, to final examinations or chemistry laboratories as they are presently conducted? How many would approve, be neutral, or disapprove the ubiquitous lecture–text–examination system? Furthermore, what are the relationships between expressed attitudes toward educational procedures and academic achievement? What are the relationships between attitudes and eventual vocational or professional success? How do students "feel" in college and after college about difficult courses which require great effort compared with easy courses in which they "never crack a book"? The chances are high that when conventional opinion attitude surveys are used, students' reactions will be distributed over the full range of like–neutral–dislike, or approve–neutral–disapprove with reference to most conventional education procedures.

In respect to both traditional and TV instruction, a real problem exists in interpreting survey responses and in determining their importance, their validity and the significance

of their content. It is a relatively easy task to prepare attitude survey schedules and to administer them to students. It is more difficult to prepare survey instruments which meet the rather rigorous requirements of scale construction. Whether opinionnaires or scales are used, there is always the question of the validity of the measuring instruments. Do students feel, believe, judge, or choose as they say they do on paper–pencil surveys? What are the constant biases which affect their responses? If they were given a realistic, overt, behavioral choice, would they actually and overtly behave in such a manner as to be consistent with their verbal statements?

In an effort to surmount the shortcomings of verbal responses to attitude questions the TV Project developed a "behavioral choice" procedure. Under this procedure students were given periods of both direct and televised instruction in the same course by the same instructor and were then required to choose between TV and direct instruction for the remainder of the semester. By obtaining students' verbal preferences before the behavioral choice was offered some interesting comparisons can be made between verbal choices and overt behavior.

Behavioral Choices of Students between Direct and Televised Lecture-Demonstrations in Chemistry

During the early Fall Semester 1955-1956 it was proposed in connection with the course in General Chemistry, to use the *behavioral test* of the attitudes of students toward televised instruction described in the previous section. The general plan involved: (a) providing students with equal periods of both direct and televised instruction, (b) using periods of sufficient length for students to become well informed about the characteristics of both methods of presentation and (c) providing students with a real, overt choice which had important values for them, i.e., giving students an actual choice between direct and televised instruction for the latter part of the course.

At the beginning of the Fall Semester 1955-1956, for the behavioral choice part of the experiment, students in each of two different sections of General Chemistry were randomly assigned into two groups, one taught directly in a lecture-demonstration hall and the other taught over television in five TV classrooms.

In both sections the groups assigned to the lecture-demonstration hall were randomized into three sub-groups. Sub-group A was assigned seats in a zone of maximum advantage in the center and front of the hall. Sub-group B was assigned seats centrally located. Sub-group C was seated in the rear of the room in zones of assumed greatest disadvantage.

Sub-groups A, B, and C of the lecture-demonstration group were equal in size and together comprised one-half of the students in each section. The remaining half of each section was assigned randomly to TV classrooms. This arrangement continued for four weeks or until the first achievement test.

At the beginning of the fifth week, those students who had been taught directly in the lecture hall were randomly assigned to the five TV classrooms. Those students who had received instruction over television in the five TV classrooms were randomized into three sub-groups and assigned seats in the lecture hall in the manner described above. Again sub-group A was placed in a zone of assumed advantage, B in an intermediate zone, and C in a zone of assumed disadvantage. This arrangement was continued for four weeks or until the second achievement test.

Thus, by the end of eight weeks, all students in both sections had experienced four weeks of direct and four weeks of televised instruction, in two different orders.

At the beginning of the ninth week all students in the two sections, one with 292 students and the other with 334 students, were taught in the lecture-demonstration hall at successive hours. The students were randomly assigned to seats and notified of their assignment by means of a posted seating chart. The first lecture of the ninth week on November 22nd was given without any announcements about seating plans or other procedures. The TV system was not in operation.

On Tuesday, November 29th, the instructor announced to both sections that students who wished to do so could move to a TV classroom at the beginning of the next lecture period. The announcement of the opportunity to choose between the assigned seats in the lecture hall and seats in TV classrooms was repeated on December 1st and 5th. On December 5th, students were told that they must make their final choice between their assigned seat in the lecture hall or a seat in one of the five TV receiving rooms. This final choice had to be made at the beginning of the lecture-demonstration on December 7th. Those remaining in the lecture-demonstration hall would remain for the rest of the semester in their assigned seats, regardless of their location. Thus, students had three lecture periods in the large lecture hall prior to each of which they could choose (a) to go to a TV classroom or (b) to remain in the lecture hall.

A preference questionnaire on attitudes toward TV was to have been given to these chemistry students but the instructors were not in favor of it. As a consequence, there was no opportunity to relate verbal preferences to actual choices.

Table 78 gives for each of the sub-groups seated in the different zones of the lecture hall, the actual number of students choosing to leave the lecture hall and go to the TV classrooms on the three days of decision. However, some of these students did not remain permanently in the TV classrooms. The totals given for December 7th are final totals for those choosing to receive instruction over television for the lecture-demonstration part of the chemistry course for the remainder of the semester.

This table shows that 187 of the 589 students in both sections (32 percent) preferred instruction over television strongly enough to leave the large class in the lecture hall and return to the TV classrooms for the rest of the semester. The number of such choices shows an interesting gradient related directly to the distance of assigned seats from the lecturer and his demonstrations. For both sections combined, about one-half of the students left zone C to continue instruction over television. The number of students choosing tele-

TABLE 78

STUDENT CHOICES BETWEEN DIRECT AND TELEVISED INSTRUCTION IN GENERAL CHEMISTRY

Location in Auditorium	*Total N*	*Number Choosing TV Dec. 1st*	*Dec. 5th*	*Final Total Dec. 7th*	*Final %*
		Section 1			
Group A 1st 6 rows	99	17	16	13	13%
Group B next 6 rows	101	33	31	31	31%
Group C next 7 rows	115	58	60	60	52%
Total all 19 rows	315	108	107	104	33%
		Section 2			
Group A 1st 6 rows	93	15	16	16	16%
Group B next 6 rows	106	32	34	35	33%
Group C next 4 rows	70	27	31	32	46%
Total 16 rows	274	74	81	83	30%

vision showed very limited variation on the three occasions of choice. It should be observed that 13 students in Section 1 and 16 students in Section 2 (15 percent) seated in zone A or the zone of greatest advantage, chose to continue the course in TV classrooms.

Chart 1 (page 76) presents a scatter diagram for Section 1 indicating students' choices as they relate to the location of their assigned seats in the lecture hall. Section 2 showed a similar pattern.

The results suggest that preference for TV instruction relates to the size of the lecture hall or the size of classes. Fewer students will choose TV teaching from among those who have had the advantage of proximity to lectures and demonstrations, even though they are in a large class.

In order to obtain an expression of reasons for their choices, personal interviews were held with ten students who remained in zone C of the auditorium, the zone of disadvantage, eight students who left this same zone for TV rooms, and nine students who left zone A, the zone of advantage. Those interviewed were selected randomly from the zone groups.

The interviews revealed that all of the ten students interviewed from the group that remained in the rear of the lecture hall had received the first four weeks of instruction directly in the same room and the second four weeks in TV classrooms. Seven of the nine students who elected TV instruction had received their first four weeks of instruction in TV classrooms and their second four weeks in the lecture hall in the front rows. This meant they left front row seats in the lecture hall for TV classrooms.

Those who chose to return to the TV classrooms seemed more sure that they had made the right choice than those who remained in the rear of the lecture hall. Apparently, some of the latter had gambled on the possibility that good seats would be left vacant by students choosing to leave for a TV classroom. However, students who chose to remain in the lecture hall had to keep their original seats.

The students interviewed were asked to state both positive and negative factors affecting their choices. Those choosing to stay at the rear of the auditorium gave as their principal reasons the absence of color in television, and the limitations of the field of view to that which the TV cameras showed. Those who moved to the television classrooms from the rear of the auditorium said that they chose television because the smaller TV rooms were more comfortable, they could see and hear better, they liked the close-up views of demonstrations on TV, and there were fewer distractions. Three of the eight students in this group did, however, mention the lack of color as a drawback for television. The reasons given by those who left the front part of the auditorium for the television rooms were that they thought that the TV rooms were more comfortable, they could see and hear better and they liked the close-ups and relative absence of distracting elements. Seven out of this group of 9 students mentioned the absence of color as a disadvantage of television.

There is little doubt that the absence of color is an important factor in the acceptance of television in the chemistry course, even though comparisons of groups taught directly and over television revealed no significant differences in course achievement.

Behavioral Choice between Direct and Televised Instruction in Elementary Business Law

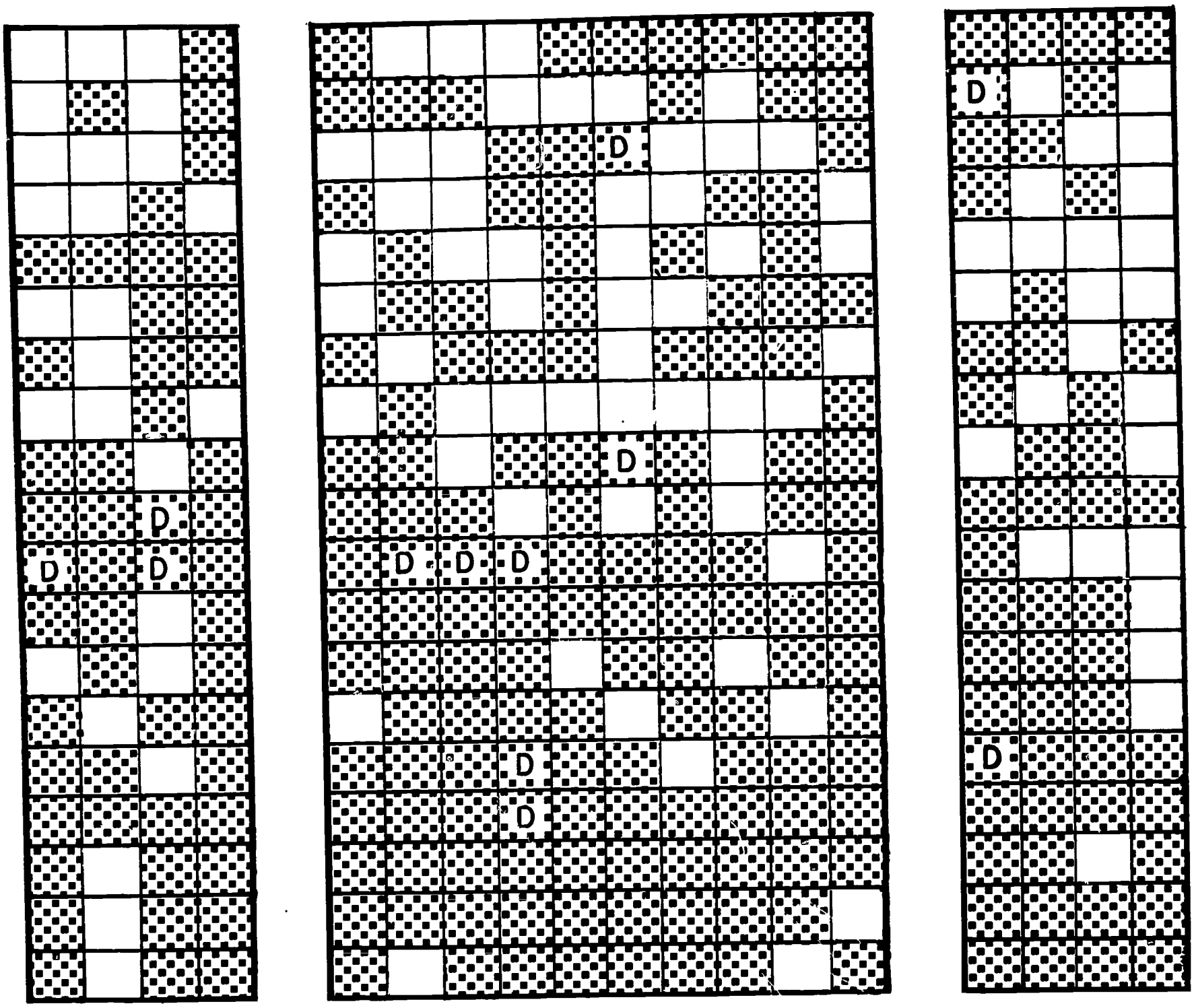
During the Spring Semester of 1956-1957 an experiment was conducted using both verbal preferences and actual behavioral choices in Elementary Business Law.

The 144 students in the class were randomized into two approximately equal groups. One group was taught directly by the professor in a large lecture hall while the other group received the same instruction at the same time in TV classrooms. One of these groups was rotated every two weeks for eight weeks, the other stayed in the TV classrooms until the mid-semester examination. All 144 students were then returned to the lecture hall. In this situation they were asked to state their preferences on a questionnaire for direct or televised instruction for the remainder of the semester. Fifty-four percent of the students expressed a preference for direct instruction. Forty-two percent favored televised instruction and four percent indicated no preference.

One week later the class was given the actual choice of going to a TV classroom for the remaining lectures or of returning to the lecture hall for direct instruction. Fifty-three percent of the students returned to the lecture hall for direct instruction. Forty-seven percent chose to return to TV classrooms and receive televised instruction for the rest of the semester.

The correlation between individual verbal responses on the questionnaire item and actual choice was 0.46. The magnitude of the correlation indicates that overt, behavioral choice cannot be accurately inferred from verbally stated preferences.

REAR



FRONT

INDICATES STUDENT WHO MOVED TO TV ROOMS □

DATE: DECEMBER 8, 1955

DROPPED COURSE D

TOTAL NUMBER OF STUDENTS 315

NUMBER OF STUDENTS WHO MOVED TO TV 104

CHART I. SEATING PLAN OF CHEMISTRY AUDITORIUM SHOWING SEATS VACATED BY STUDENTS WHO CHOSE TELEVISED INSTRUCTION

Relation between Course Achievement and Choice. The relationship between the behavioral choice made by the students and their academic achievement in this course was also investigated. A correlation was computed (1) between the behavioral choices made and the students' scores on the second examination in the course (held prior to the offer of the behavioral choice), and (2) between their behavioral choices and the scores made on the final examination in the course. The first correlation coefficient was .06 and the second .04 These figures indicate that there was no measurable relationship between the choice made and performance in the course.

Behavioral Choice between Direct and Televised Instruction in Introductory Political Science

Introductory Political Science was taught over television during the first part of the spring of 1956 with the instructor in a small originating room with no students present. The 219 students received instruction in small and medium size TV classrooms. Then, for several weeks all students were moved to a large classroom and taught directly.

After these two experiences students were asked to express in writing their preferences for televised or direct instruction for the remainder of the semester. At the next class period students were told that on May 9th and 11th they would be given a "free" choice between staying in the large lecture hall where the instructor would teach the class directly, or of returning to the TV classrooms where they had earlier received the televised instruction.

It should be observed that in the behavioral choice situation the instructional conditions were slightly different from those the students had originally experienced. In order to accommodate those desiring direct instruction and those choosing TV, the TV presentation had to originate in the large classroom rather than the small TV originating room. Thus, those who chose to receive direct instruction in the large classroom now had a situation where TV cameras were also present. Those who chose TV, experienced presentations which now originated in a large classroom rather than in a small TV originating room. It is believed that because of the type of instruction which was primarily lecture-blackboard in type, the changes which were made in the conditions of presentation did not seriously affect student choices. Furthermore, there were two "free" choice days, so that students could change their choice if they so desired. Very few did change.

TABLE 79

Verbal Preferences and Behavioral Choices for Televised or Direct Instruction in Political Science

Response	*Televised Instruction*	*Direct Instruction*	*Indifferent*
Verbal Preference	51%	46%	3%
Behavioral Choice (3% absent)	70%	27%	

Table 79 presents the percentages of written responses and comparable data in behavioral choices based on attendance records.

The data show the highest percentage of students choosing televised instruction thus far obtained in behavioral choice studies. Furthermore, verbal preferences were very different from actual behavioral decisions. The correlation between the verbal preferences and overt choice was found to be only .33. In this course more students actually elected televised instruction than said they would do so. These results, and somewhat similar results in Elementary Business Law, suggest that responses to questionnaires may not be accurate indicators of real choice behavior.

The reasons students gave for their choices are interesting. Table 80 gives the stated reasons.

TABLE 80

Reasons Given by Students Who Preferred TV

Responses	*Frequencies (N)*
Small TV rooms were more conducive to concentration	30
Not much difference	18
Too much noise and interruption in large class	14
This instructor better on TV	11
TV holds attention better	10
Smoking permitted in TV rooms	2
Instructor easily disturbed and distracted in large face-to-face class	2
Wanted to be with friend in TV room	1

There were other reasons mentioned by individual students, but they added little to the reasons listed above.

Relationship between Course Achievement and Behavioral Choice. In this study in the Political Science course it was possible to obtain information concerning two questions of considerable interest:

(1) What is the relationship between performance in the course and the choices made by the students for TV or direct instruction?

(2) What is the relationship between behavioral choices and the students' scores on the Inventory of Beliefs which attempts to measure students' attitudes on a liberal–authoritarian continuum?

Point biserial correlations were computed. These were as follows:

(1) The correlation between behavioral choice and scores on the examination held prior to the choice was .12.

(2) The correlation between behavioral choice and scores on the final course examination was .15.

(3) The correlation between behavioral choice and scores on the Inventory of Beliefs was .06.

None of these correlations were significant, and thus no relationships were found between course achievement and choice, or between choice and students' positions on a liberal-authoritarian scale.

Assessment of Student Attitudes toward Direct and Televised Instruction Using a Majority Vote in General Psychology

The assessment of student attitudes toward TV instruction by arranging an actual choice, as was done in chemistry, business law and political science emphasizes individual decision. Another method which involved actual choice behavior with real consequences was also applied. This was the method of majority vote, which may permit both individual and social determinants (group pressures) to operate. The method allows for the possibility that some students will attempt to influence the vote of others, given time. It should be made clear to all students when this procedure is used that the majority vote will decide whether the students will have direct or televised instruction for the remainder of the semester.

The experimental design for comparing two patterns of presenting General Psychology during the Spring Semester of 1956-1957 included provision for testing the following:

(1) Student preferences for direct or televised instruction as indicated by a majority vote procedure (after having had TV instruction for 9 weeks followed by direct instruction for 3 weeks).

(2) The hypothesis that students who have received adapted or highly visualized TV instruction will prefer TV instruction to a greater degree than those who have received conventional lecture-blackboard instruction over television.

(3) The hypothesis that students will prefer receiving televised instruction in small and medium sized rooms rather than receiving the same TV instruction in a large lecture hall.

The main part of this experiment was a comparison of adapted TV versus conventional, direct lecture-blackboard instruction in terms of student achievement. Two large TV sections of about 300 students each were taught over television from a small originating room with no students present during consecutive hours by the same instructors. Each section contained a randomized experimental core of students, 81 in one section and 110 in the other. The first section received an adapted version with considerable emphasis on visual-graphic materials and actual demonstrations; the second section received a straight lecture-blackboard version of the course. Both sections received instruction over television for the first nine weeks of the course up to the third examination. From the ninth to the twelfth week each section was taught directly in a large lecture hall (capacity 400 students). During these three weeks both sections were given the same instruction directly by the lecture-blackboard method and by the same instructors.

Student Preferences. At the end of the twelfth week the students were given a choice, with the majority vote being decisive, between continuing in the large lecture hall, or returning to the receiving rooms where they had received the first nine weeks of instruction over television.

Table 81 gives a summary of the results of the vote for all students, for both sections, and shows the rooms where they had received TV instruction.

TABLE 81

PREFERENCES OF STUDENTS FOR DIRECT OR TELEVISED INSTRUCTION IN GENERAL PSYCHOLOGY

Original Condition	*Total N*	*Prefer TV N*	*Percent*	*Prefer Direct Instruction N*	*Percent*	*Indifferent N*	*Percent*
Section 1 (Adapted TV instruction for first nine weeks and direct lecture-blackboard instruction for three weeks)							
Students who originally received TV in large room	121	68	56%	51	42%	2	2%
Students who orignally received TV in small rooms	113	75	66%	37	33%	1	1%
Combined groups	234	143	61%	88	37%	3	2%
Section 2 (Lecture-blackboard TV instruction for first nine weeks and direct lecture-blackboard instruction for three weeks)							
Students who orignally received TV in large room	158	75	47%	80	51%	3	2%
Students who orignally received TV in small rooms	152	87	57%	63	42%	2	1%
Combined Groups	310	162	52%	143	46%	5	2%
Combined total (both sections)	544	305	56%	231	42%	8	2%

It can be seen that in Section 1 (the adapted TV group) 61 percent voted for TV, 37 percent for direct instruction with 2 percent expressing no preference. In Section 2 (the lecture-blackboard TV group) 52 percent chose TV, 46 percent direct instruction with 2 percent having no preferences.

The combined votes for both sections showed that 56 percent voted to return to televised instruction under the conditions which prevailed during the first nine weeks, while 42 percent voted to continue direct instruction in the large classroom. It is important to note that 121 students in Section 1, and 158 students in Section 2 had originally received TV instruction in the large lecture hall over six receivers. In both sections of the course a smaller proportion of the students originally in this large room chose to return to TV than

the proportion of those who had originally been in the small TV viewing rooms.

Table 82 shows the preference votes of the randomized core groups in each section in relation to the rooms where they had been assigned for the first nine weeks.

TABLE 82

PREFERENCE OF CORE GROUPS FOR DIRECT AND TELEVISED INSTRUCTION IN GENERAL PSYCHOLOGY

Original Condition	*Total N*	*Prefer TV N*	*Prefer TV Percent*	*Prefer Direct Instruction N*	*Prefer Direct Instruction Percent*
Section 1 (Adapted TV instruction for first nine weeks)					
Students who received TV in large room	30	16	53%	14	47%
Students who received TV in small rooms	29	21	72%	8	28%
Combined Groups	59	37	62%	22	38%
Section 2 (Lecture-blackboard TV instruction for first nine weeks)					
Students who received TV in large room	39	16	41%	23	59%
Students who received TV in small rooms	49	30	61%	19	39%
Combined Groups	88	46	52%	42	48%
Combined Total (both sections)	147	83	57%	64	43%

The results for the randomized core groups parallel those for the entire population of students in the course for both sections combined; 57 percent voted to return to TV instruction as it was given for the first nine weeks, and 43 percent expressed a preference for direct instruction in the large classroom. According to the proposal that the majority vote would rule, all students in the two sections were returned to TV classrooms and instructed for 4 more weeks over television or until the final examination.

TABLE 83

PREFERENCES FOR TELEVISED OR DIRECT INSTRUCTION WITH RESPECT TO TRADITIONAL OR ADAPTED TV INSTRUCTION

Original Condition	*Prefer TV N*	*Prefer TV Percent*	*Prefer Direct N*	*Prefer Direct Percent*	*Total N*
Adapted Section	37	62%	22	38%	59
Lecture-Blackboard Section	46	52%	42	48%	88
Totals	83	57%	64	43%	147

Preference Difference for Adapted vs. Traditional TV Instruction. One of the hypotheses to be tested was that the students who received the adapted version of the course would reflect a stronger preference for TV instruction than the students who received on TV a conventional lecture-blackboard version of the course.

Table 83 presents the data of a chi square analysis of the preferences of those students in the randomized core groups.

Although the proportion of students choosing television was 10 percent higher for the group who received the adapted TV presentation, the analysis yielded a chi square of 1.17 which did not reach the .05 level of significance. Thus, adaptation of the course did not affect the choice significantly.

Preference Difference for Large TV Room vs. Small TV Rooms. The third hypothesis was that students who had experienced 9 weeks of the course in small TV viewing rooms with one or two receivers and seating capacities of 30 to 50 would prefer TV teaching to a greater extent than the students who had experienced that period of the course in the large lecture hall with six receivers and a seating capacity of 400 students.

Table 84 presents the data for the randomized core groups for both sections combined.

TABLE 84

PREFERENCES FOR TELEVISED OR DIRECT INSTRUCTION WITH RESPECT TO LARGE OR SMALL TV RECEIVING ROOMS

Original Condition	*Prefer TV N*	*Prefer TV Percent*	*Prefer Direct N*	*Prefer Direct Percent*	*Total N*
In large TV room	32	46%	37	54%	69
In small TV rooms	51	65%	27	35%	78
Totals	83	56%	64	44%	147

An analysis showed that the chi square = 4.64 with a $p < .05$. Thus, students who had the first nine weeks of the course in small TV classrooms preferred TV instruction to a significantly greater extent than those students who had the course in a large TV-equipped lecture hall.

These results indicate that the physical situation determined by size of room, size of class and arrangements of television receivers may affect student preferences for televised instruction.

Reasons for Students' Choices. An attempt was made to have students record the reasons for their votes. The following table give reasons for different categories of students. Reasons are reported which were listed by two or more students.

These lists of reasons suggest several comments: Students in small TV classrooms seemed to express more favorable reactions and fewer unfavorable reactions toward televised instruction than those in the large room equipped with TV receivers. Many of the same reasons were given for choosing both the large classes directly-taught and televised instruction.

TABLE 85

PREFERENCES OF STUDENTS IN SECTION 1 (ADAPTED TV INSTRUCTION) FOR RETURNING TO TELEVISED INSTRUCTION UNDER CONDITIONS HOLDING DURING THE FIRST NINE WEEKS OF GENERAL PSYCHOLOGY

Responses	*Originally in Small TV Rooms*	*Originally in Large TV Room*
Can see and hear better	39	31
Less interruption, distraction, noise and confusion	30	21
Too many in directly-taught class; too crowded	11	5
Easier to understand on TV	4	8
Can attend better	5	7
Uses more teaching aids	7	1
Easier to take notes on TV	4	0
Better instruction on TV	3	3
Can concentrate better in TV	3	2
Better seating	1	2
More repetition of important data over TV	2	0
Easier to leave room and class	2	0

TABLE 86

PREFERENCES OF STUDENTS IN SECTION 1 (ADAPTED TV INSTRUCTION) WHO PREFERRED DIRECT INSTRUCTION IN LARGE ROOM

Responses	*Originally in Small TV Rooms*	*Originally in Large TV Room*
More active participation and questions	7	31
More interesting	3	11
Easier to understand	5	10
Closer contact with teacher	9	9
Can attend better	8	4
Can take better notes	3	1
Easier to concentrate	2	2

TABLE 87

STUDENTS IN SECTION 2 (LECTURE-BLACKBOARD TV PRESENTATION) WHO PREFERRED TO REMAIN IN LARGE ROOM FOR DIRECT TEACHING

Responses	*Originally in Small TV Rooms*	*Originally in Large TV Room*
Better chance to ask questions	13	22
More difficult to concentrate with TV	13	14
Understand better with instructor present	0	19
Closer contact between teacher and students	12	8
Nice having a live instructor	18	5
TV is boring	1	13
More informal and personal	6	0
Lecturer keeps order	3	8
Can see and hear better	0	5
Better suited to learning	4	0
Easier to take notes	4	6

TABLE 88

STUDENTS IN SECTION 2 (LECTURE-BLACKBOARD TV PRESENTATION) WHO PREFERRED TO RETURN TO TV INSTRUCTION UNDER CONDITIONS HOLDING DURING FIRST PART OF COURSE

Responses	*Originally in Small TV Rooms*	*Originally in Large TV Room*
Too crowded in directly-taught large group	33	28
Too noisy and confusing in large group	27	30
Too hot in large group	24	21
See better in TV rooms	19	12
Harder to hear in large room	27	5
Easier to ask questions in small TV rooms	6	2
Remember more from TV lectures	6	0
Easier to concentrate in TV classes	5	4
More accomplished through TV teaching	2	2
Distractions, people entering and leaving in large room	5	1
Students restless in rear of large room	1	2
Better blackboard work on TV	4	0
TV holds attention better than face-to-face	0	4
Small TV classes more orderly	0	3

Student Preferences for Two Methods of Using Television Expressed by Majority Vote in Introduction to Education

During the spring of 1956, a class of 175 students was instructed for four weeks in a large lecture hall using a single television camera for presenting audio-visual aids. A film chain was also used along with a good sound system and six 24" TV receivers. The receivers were situated along the two lateral aisles of the room so that one or more could be easily viewed by each student. In this situation students could direct their attention to several sources of information, the instructor and his presentations in the front of the room, and/or the TV receivers. Films were also presented on these receivers.

Subsequently, for three weeks all students were moved to TV classrooms which ranged in seating capacity from 30 to 50 seats. They received instruction similar to that previously given over the TV system in the large room. The instruction was given by the teacher from a small central originating room. No students were present in this room. Therefore, this arrangement was the same as that used for most TV courses at Penn State.

These procedures gave students four and three weeks of experience respectively with two patterns of instruction. First, they had direct instruction plus televised video information originated and transmitted to receivers in the same large classroom. In this situation television served to enlarge and project pictorial-graphic materials to students and to present films. Second, students had experience with instruction distributed to small and medium size TV classrooms. The stage was set for providing students with a real choice between these two patterns of instruction.

At the end of seven weeks the instructor reviewed for the class the fact that two patterns of instruction had been used, both involving different applications of closed-circuit television. The instructor proposed that students choose between the two arrangements. This would be done by secret ballot and the majority vote would determine which arrangement would be used for the remainder of the semester. The students were to vote their choice between the large lecture hall application and the distributed application using TV classrooms. Ballots were distributed and students made their choices.

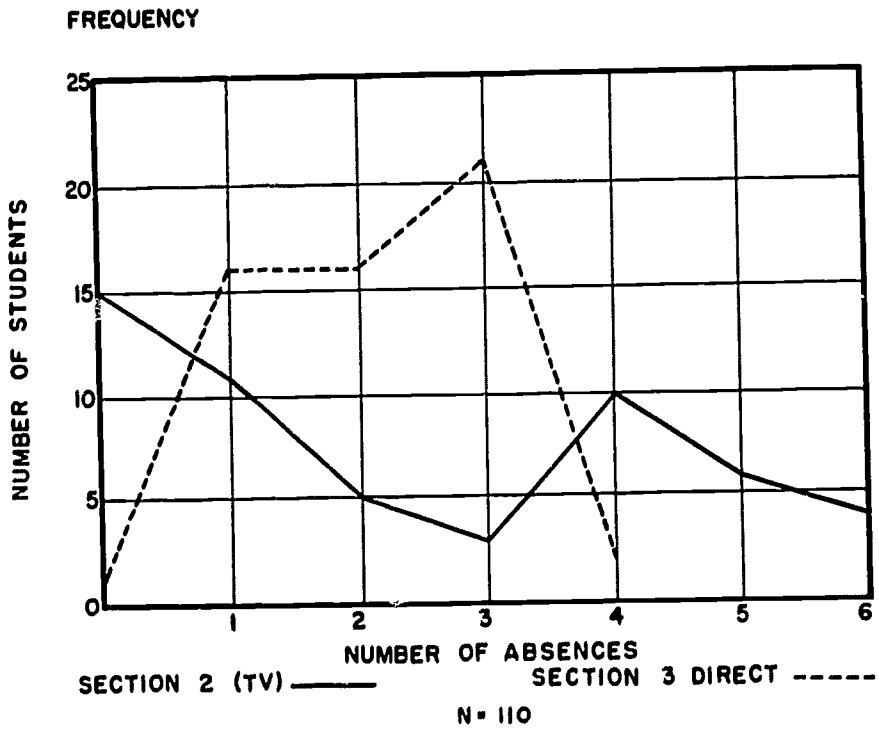
Tabulations of ballots showed that 61 percent favored receiving instruction for the rest of the semester in small TV classrooms, and 39 percent preferred continuing the course in the large lecture hall.

It should be noted that the announcement of the opportunity to choose between the two patterns, followed immediately by a vote, required responses without time for prolonged deliberation or discussions with other students.

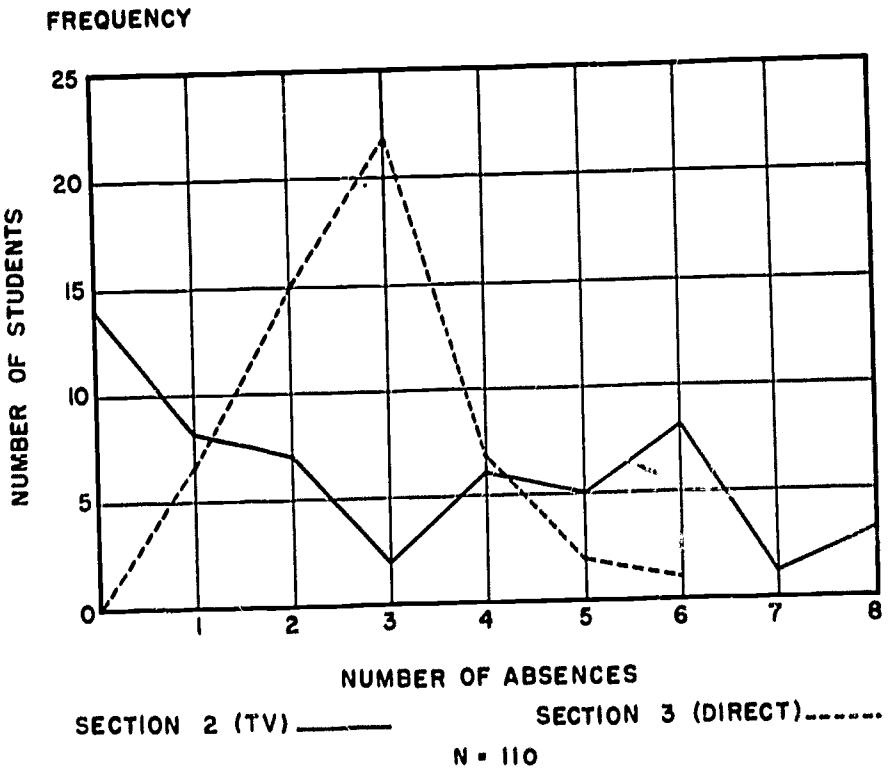
Effects on Class Attendance of Experimental Variables in Meteorology

Following a period in which experimental conditions of compulsory attendance and non-attendance were in force,[1] a second experimental period, which included the four weeks between the second and third examinations, was introduced. The condition of this second experimental period was optional attendance. All students who took part in the first experiment in both the TV and non-TV classes were told that they were free to attend or not to attend the meteorology classes.

Comparisons and analyses of attendance records for the four weeks of optional attendance showed no differences between the compulsory attendance and non-attendance groups nor were there statistically significant differences



GRAPH 1. ABSENCES FOR OPTIONAL PERIOD TV VERSUS DIRECT INSTRUCTION METEOROLOGY



GRAPH II. TOTAL ABSENCES TV VERSUS DIRECT INSTRUCTION METEOROLOGY

[1] Reported in Chapter 2, pp. 31-32.

(t-test) between attendance under the two conditions of the directly-taught compared with the TV-taught section. The mean scores for all comparison groups were about the same. However, when the frequency of absences was plotted during the optional attendance period and for the entire semester, the curves showed marked differences in dispersion or pattern of absences between the TV and direct instruction sections.

Graphs I and II show the patterns of attendance records or absences.

A Bartlett test of homogeneity of variance on the data for the experimental period yielded a chi-square value of 27.10 which was significant beyond the .01 level and supported the graphically presented findings of heterogeneous dispersion in attendance between the TV and direct-instruction experimental groups. Comparison of absences in the conventional and TV sections shows that the average number of absences is about the same. Many more students in the TV section had *no* absences as compared with those in the conventional or directly-taught section. Likewise, fewer students in the TV section had one, two, and three absences. However, there were more students for the TV section who had four, five, and six absences. In summary, it can be observed that the form of the curves both for the four weeks of optional attendance and for the entire semester has roughly a U or J shape for the TV section and a roughly *normal* shape for the conventionally-taught students.

Interpretations of the factors which produce these differently formed curves are difficult to make. It is suggested that the behavioral measure of class attendance may reflect the same bi-modality of distribution and is similar to distributions of verbally expressed attitudes toward TV instruction. The bi-modal curve for the TV class contrasted with the normal curve for the conventional class and may reflect differential reactions of students to conformist pressures. Attendance in TV classes may depend more on personal motivation than it does in face-to-face classes with an instructor present. In the latter, conformist pressures apply to a greator extent because of the presence of the instructor. TV classes may be more permissive and some of the less responsible and less mature students feel less pressure for conformity and may cut more classes.

Relative to this latter point a question was raised about the correlation between class attendance and examination scores. A product-moment correlation coeffecient was calculated between absences of students during four weeks of optional attendance and the examination scores for that period. The correlation for the TV group was –.20 and that for the conventional group was .11. These figures indicate that there was little relationship between class attendance and achievement in this course.

Some Observations on Results of Choice Studies

The method of providing for real choice behavior yields results which are easily interpreted. The problem of validity of the results is no longer an issue. The method is certainly superior to questionnaire and opinion surveys in which the subjects have little or no investment in the consequences of their responses.

A review of the results for chemistry, business law, education and political science shows that acceptance of instructional television by students varies with a number of factors. Some of these are:

1. Size of class and classroom
2. Distance of assigned seats from lecturer and demonstrations
3. The general methods of teaching
4. The personality of the teacher
5. Quality and adequacy of video and sound presentations
6. Classroom atmosphere
7. Content of the course

These factors cannot at present be arranged in an order of importance. There are probably other determinants of students' decision behavior.

Finally, for the courses studied, the differences between direct and televised instruction as perceived by Penn State students are not great enough to result in very strong negative or positive action for either procedure.

Opinion and Attitude Surveys of Students Relative to Televised Instruction

Conducting attitude and opinion surveys of students with reference to their reactions to televised instruction has become a widespread standard practice. These surveys were done regularly with almost every course taught over television at Penn State until the behavioral choice method was introduced. A large mass of results of such surveys is available but it is impractical to reproduce all of this material. Since the methods of behavioral choice and majority vote yield results of greater intrinsic value, these have been fully reported.

It is a difficult and persistent problem to interpret the results of the surveys and assess their importance relative to scholastic behavior and academic achievement. These latter considerations are of prime importance. The personal prejudices and behavior of students with regard to televised instruction become subordinate, once general acceptance of TV instruction has been established in an institution. Scholarly objectives then become most important.

It is abundantly clear that the attitudes expressed by students toward televised instruction are not homogeneous single-mode responses. These responses vary rather widely from course to course with television being a constant factor. The attitudinal responses are conditioned by the characteristics of students themselves and by the characteristics of the instructor. Furthermore, the interests of students relative to the course content, influence opinions. The level of difficulty of the course content, the general methods used and a number of other factors are involved.

Not all data collected can be reported here, therefore selected data will be reported. To aid in the selection and to present a more coherent report, the following statements

and propositions will be given and detailed reports supporting them will follow:

1. Beginning with the level of expressed acceptance of televised instruction at Penn. State in 1954-1955, there has been a gradual average change to a somewhat higher level of acceptance. This positive change related principally to the high quality of instructors and instruction in the courses presented over television and to improvements in the quality of television operations.

2. Within a given course, two changes generally occur in the opinions and attitudes of students toward TV: a. Opinions become more definitely structured and firmly held as the semester progresses; there are changes in the frequency of responses from the neutral, no preferences, or indifferent categories both toward the negative and positive poles of the attitude continuum. b. Generally there is more change toward the positive than to the negative categories although this is not always true.

3. The form of frequency curves of student responses plotted on a five point scale ranging from negative to positive shows wide variations from course to course. Some degrees of these variations seem to be more a function of the non-TV than the TV elements of the course.

4. The fourth proposition or hypothesis, which is supported by observations but not by quantitative evidence, is that students seemed to be much less concerned or aware of television *per se* in 1956-1957 than they were in the spring of 1954-1955. Specific reactions to television as such are becoming reduced, both in number and intensity. Students appear to be discriminating more clearly than formerly between televised presentations and other more central factors in their instruction. For example, the quality and characteristics of the instructor, the quality of the presentation and the significance of the course material become more meaningful. Television as used in instruction appears to be assuming the value, as set by students, of an instrument like a telephone or radio. It is a means by which course instruction is presented to them, and television itself is not that instruction. Furthermore, television relates only peripherally to their learning. It appears that student opinions and evaluations of televised instruction are beginning to agree with what research has already shown, namely, "Television *as such* doesn't make much difference" in the students' achievement in the course.

5. Another proposition is that a gradual but pervasive opinion is developing among students that when they take TV courses they have a good chance of getting the best instructor (s) that a department can provide. Students regularly comment that instructors who are teaching over television prepare their materials better than the average instructor.

If this continues to be true and TV courses gain the reputation among students that they are indeed the best that can be offered at Penn State, acceptance of TV instruction by serious students is assured.

Examples of Attitude and Opinion Surveys in Different Courses

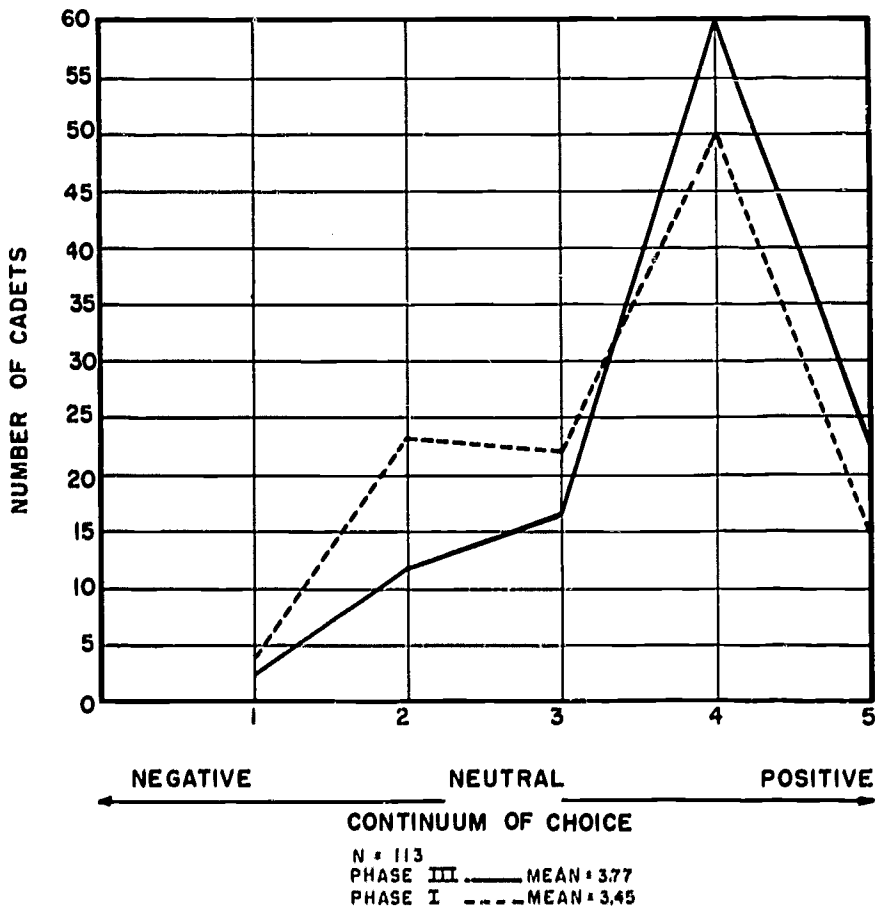
The following section presents examples of the results of surveys of student attitudes in specific courses.

Air Science, Fall and Spring Semesters 1955-1956. A survey was made in this course after three weeks of instruction and repeated at the end of the semester on the same students. An item included in each survey was: "After having participated in a TV section, I find that:

Scale Value

(5) I enjoyed it very much
(4) I enjoyed it somewhat
(3) I have no particular feelings about it
(2) I dislike it somewhat
(1) I dislike it itensely

Graph III gives the two distributions, using scale values as indicated above, after three weeks and at the end of the semester, in terms of the number of students checking each item on both surveys.

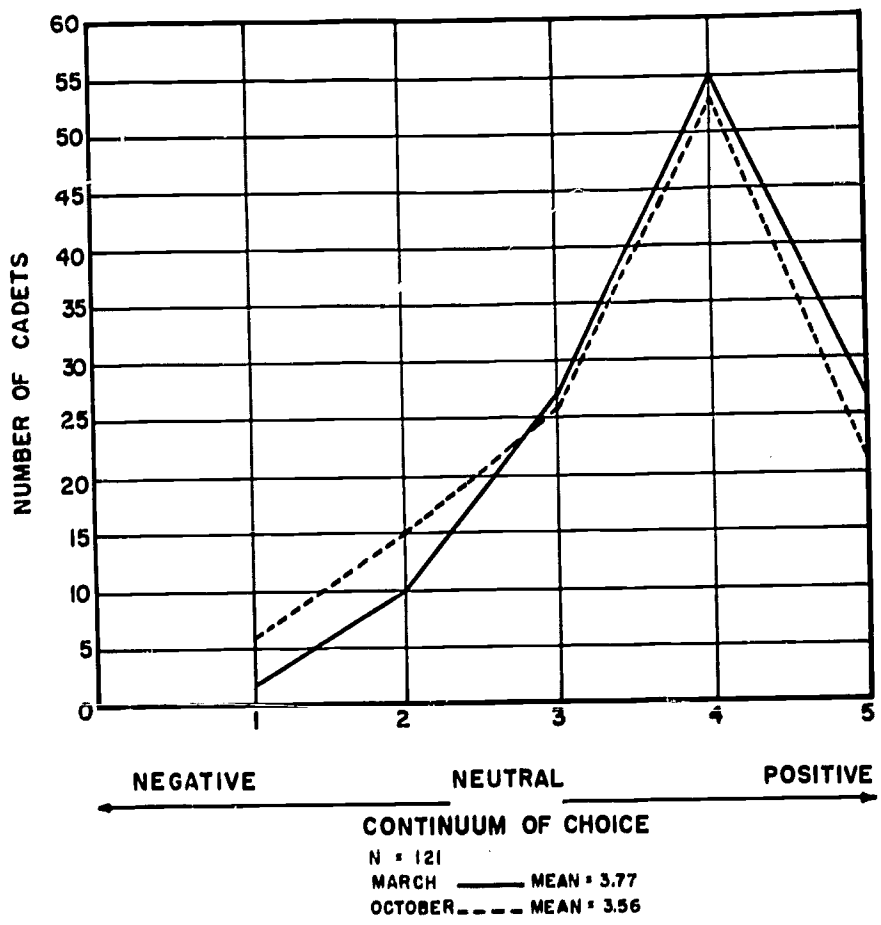


GRAPH III. STUDENTS' ATTITUDES TOWARD TELEVISED INSTRUCTION AFTER THREE WEEKS AND AT END OF COURSE IN AIR SCIENCE

There was a change from the more negative toward the more positive direction. There was an increase in the "like" group from 57 percent to 73 percent and a decrease in the neutral category.

A study was also made in Air Science covering the period of time from October 20, 1955 to March 1, 1956 or slightly over four months. The same "like–dislike" item stated above was used and responses from each student were obtained in two surveys.

The results are given in Graph IV.



GRAPH IV. CHANGES IN STUDENTS' ATTITUDES TOWARD TELEVISED INSTRUCTION IN AIR SCIENCE BETWEEN OCTOBER 5, 1955, AND MARCH 1, 1956

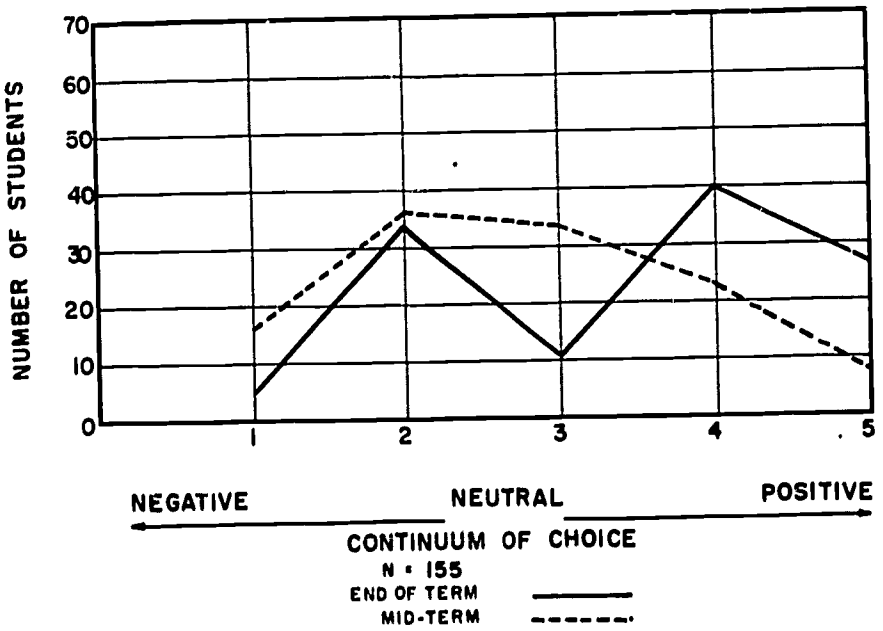
The graph shows a change favoring televised instruction. There was an increase in the "like" categories from 61 percent to 67 percent and a decrease in "dislike" categories from 17 to 9 percent. Neutral scores remained almost unchanged.

Principles of Economics, Fall Semester 1955-1956. The 155 students in this course were asked to express their general "likes–dislikes" toward televised instruction both at the mid-term (after about 8 weeks of instruction) and at the end of the semester.

For the "enjoyed it very much" or "enjoyed it somewhat" categories there was an increase from 27 percent to 58 percent. The "have no particular feelings about it" category decreased from 28 percent to 9 percent. The "dislike it somewhat" or "dislike it very much" categories decreased from 45 percent to 33 percent.

Graph V presents the curves for both surveys on a 5 point scale.

Elementary Business Law, Fall Semester 1955-1956. The 189 students in Elementary Business Law during the fall of

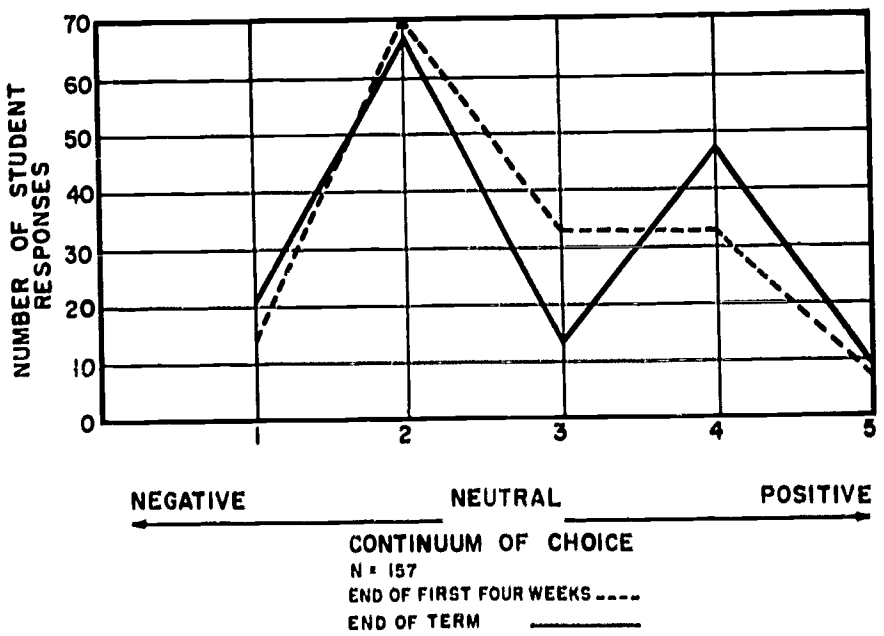


GRAPH V. STUDENTS' ATTITUDES TOWARD TELEVISED INSTRUCTION AT MID-SEMESTER AND AT END OF TERM IN PRINCIPLES OF ECONOMICS

1955-1956 were divided into four groups. Section A spent four weeks in a large classroom where the instructor taught the group while originating instruction for TV classrooms. Groups B and C alternatively spent two weeks in the originating room and in TV rooms. Group D received four weeks of instruction in TV classrooms.

The opinions and attitudes of students were surveyed at the end of four weeks of the course and again at the end of the semester. The enjoyment or like–dislike item of the questionnaire was used and a frequency plot made of students' responses which were available from both surveys.

Graph VI presents the plotted results of responses on the 5 point scale for the end of the first four weeks and at the end of the semester.



GRAPH VI. STUDENTS' ATTITUDES TOWARD TELEVISED INSTRUCTION AFTER FOUR WEEKS AND AT END OF SEMESTER IN BUSINESS LAW

This frequency polygon once again shows a bi-modal distribution. In this course the "dislike it somewhat" category has a higher frequency on both plots than the "enjoy it somewhat." However, there was a significant increase in the latter category between the end of the fourth week and end of the semester survey. Typically there was a shift from the neutral zone of responses mainly in the positive direction. Nevertheless, a high negative peak also characterized the end of semester responses. This exceptional pattern in Elementary Business Law may have been a function of the characteristics of the instructor who gave dramatic lectures and stimulated considerable response from the face-to-face group. The pattern of reactions may also have been related to the general manner in which the course was conducted, or the effect could have resulted from the rotational schedule of students. Students generally seem to react against too much change of any kind in the conduct of a course. They seem to prefer a set routine.

Psychology of Marriage, Fall Semester 1955-1956. The main research objectives in this course during the Fall Semester of 1955 were to study the effects of varying sex compositions of TV classes and the effects of required and voluntary attendance.[1] Incidentally, as a part of other attitude surveys, the usual "like–dislike" item with 5 categories was included. Two surveys were made, one at about the mid-semester and another at the end of the semester.

Table 89 presents the numerical results of both surveys.

TABLE 89

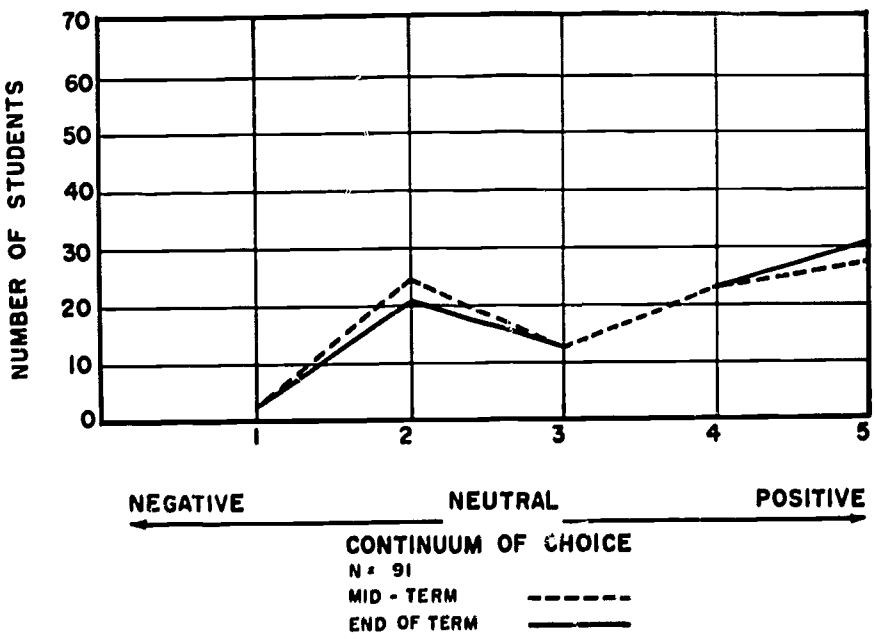
STUDENT REACTIONS TO TELEVISED PRESENTATION IN PSYCHOLOGY OF MARRIAGE

Response	*Mid-Term Frequencies*	*Percent*	*End of Semester Frequencies*	*Percent*
Enjoy it very much	27	30%	31	34%
Enjoy it somewhat	23	25%	23	25%
Have no particular feelings	13	14%	13	14%
Dislike it somewhat	25	27%	21	23%
Dislike it intensely	3	3%	3	3%
Totals	91	99%	91	99%

The same data are shown in Graph VII.

This graph shows a slight reduction in the "dislike somewhat" category by the end of the semester. The "no particular feelings" category showed no change, and there was a slight increase in the extreme positive reaction to televised instruction.

1 Reported in Chapter 2, p. 23 and p. 25.



GRAPH VII. STUDENTS' ATTITUDES TOWARD TELEVISED INSTRUCTION AT MID-TERM AND AT END OF TERM IN PSYCHOLOGY OF MARRIAGE

General Psychology, Fall 1955-1956. For the 1955 Fall Semester, General Psychology was taught by five different instructors. In addition to several other research projects, the attitudes of students in Section 2 of the course toward televised instruction were surveyed at mid-term and end of term.

Table 90 gives the numerical data for each survey and for the responses to each category.

TABLE 90

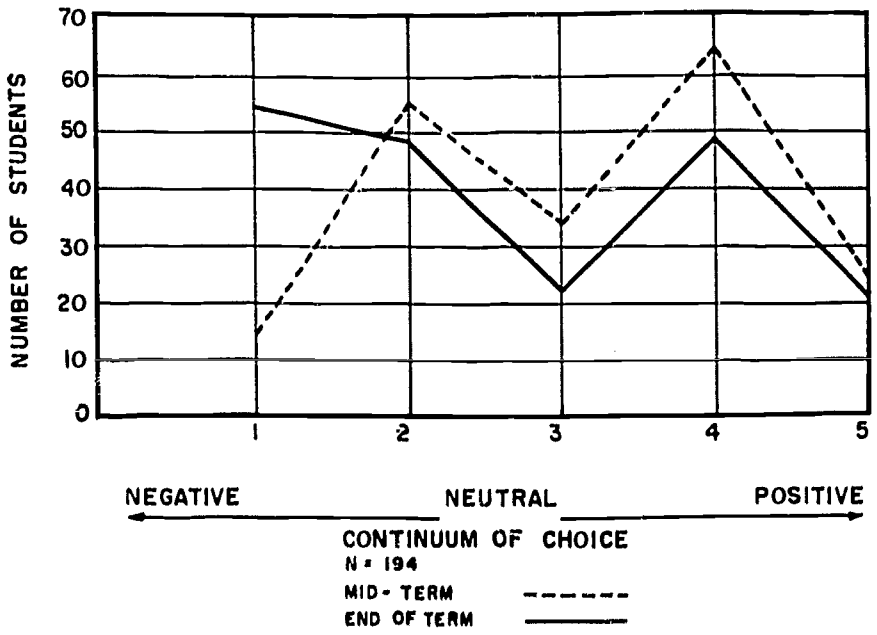
STUDENT REACTIONS TO TELEVISED PRESENTATION IN GENERAL PSYCHOLOGY (SECTION 2)

Response	*Mid-Semester Frequencies*	*Percent*	*End of Semester Frequencies*	*Percent*
Enjoyed it very much	26	13.4%	21	10.8%
Enjoyed it somewhat	64	33.0%	48	24.7%
Have no particular feelings	34	17.5%	22	11.3%
Disliked it somewhat	56	28.9%	49	25.3%
Disliked it intensely	14	7.2%	54	27.8%
Totals	194	100 %	194	100 %

Graph VIII represents the data given above for mid-semester and end of semester responses of students in Section 2 of General Psychology.

The results of these surveys show that attitudes as expressed moved in a negative direction for all categories. This negative drift in the second half of the semester is judged to be reliable.

The interpretation made by the Project staff is that this negative drift related to demands made on students by



GRAPH VIII. STUDENTS' ATTITUDES TOWARD TELEVISED INSTRUCTION AT MID-TERM AND AT END OF TERM IN GENERAL PSYCHOLOGY

several complex research problems. In this course during this semester, research was done on the 35-minute lecture plus 15-minute discussion plan, different methods of proctoring the course and other problems. The experimental requirement for dismissing some students during the discussion period was especially annoying to students. There is little question but that the demands made on students in the interest of experimentation had an adverse effect on attitudes toward the TV course during this particular semester. Another variable which was reacted to negatively by students was the use of five instructors. They seem to accept two or three different instructors but are confused and resent a larger number of teachers in one course. Finally, some confusion was created by the variety of behavior and attitudes of the TV classroom proctors.

Student Reactions to TV Instructors

Student Judgments of Teacher Attitudes toward Them in Direct and Televised Instruction in Sociology

Students react differentially in terms of their judgments of the attitudes of teachers toward them. In televised instruction some students report that compared with direct instruction the teachers seem "closer" to them over television; other students report that they seem "remote and far away". Subtle and complex attitudes of the instructors toward students are expressed and perceived by students.

In the Spring Semester of 1956 a study was made in Introductory Sociology on students' judgments of their acceptance or rejection by the same professor, using television for one section and direct instruction for another section. The method used was to have students complete a check list of forty-three adjectives which had been developed by H. C. Peters for use in research measuring client-clinician acceptance in a clinical situation.[1] The students in Sociology were asked to check yes or no to such adjectives as helpful, patient, sympathetic, sincere, anxious, nervous, etc. Opposites of most adjectives were also included in the list, for example, impatient, unsympathetic and insincere. Thus, an internal consistency measure was available for responses of subjects.

A comparison of frequencies of responses was made for two groups of students taught by the same professor, one group taught directly and the other over television. The reactions of students to the professor under the two conditions were very similar. The correlation between the percentages of responses to items yielded a figure of .99. This established the fact that, on the basis of the measures used for rejection and acceptance, this teacher was judged to have the same attitude toward students whether he was teaching directly or over television.

Reactions of Students toward the Instructor in Direct and Televised Introductory Sociology Classes

It is the exceptional instructor who is not concerned about the attitudes of students toward him both as a teacher and as a person. It is assumed that a teacher's estimate of the effects of televised instruction on the attitudes of students toward him affects his willingness or reluctance to give his course over television. Furthermore, the lack of such student responses as approval, recognition and esteem, reactions to humor and expressions of interest may deprive the instructor of important rewards and incentives associated with teaching. Hence, it is important to study the question of how students view and judge their TV instructors.

Students in directly-taught and televised sections of Introductory Sociology during the Spring Semester 1956 were asked to rate their instructor compared with others they had in different courses. Table 91 shows the results.

TABLE 91

Student Ratings of a Teacher Under Conditions of Direct and Televised Instruction

Response	*Direct (N = 126)* *Frequency*	*Percent*	*TV (N = 119)* *Frequency*	*Percent*	*Percent Diff. for TV*
Better than average	54	43%	52	44%	+1%
Average	39	31%	31	26%	—5%
Poorer than average	20	16%	29	24%	+8%
Miscellaneous	13	10%	7	6%	—4%

Some slight differences in ratings of the instructor are shown between the direct and televised sections.

Students in Sociology were asked to list a single favorable and unfavorable factor about their teacher and his lectures. Table 92 gives the ten factors listed most frequently for both directly-taught and TV classes.

[1] Peters, Harold C. *A Comparison of Two Methods of Group Psychological Test Interpretation.* The Pennsylvania State University, 1955.

TABLE 92

FAVORABLE AND UNFAVORABLE FACTORS ABOUT THEIR INSTRUCTORS AS LISTED BY STUDENTS IN SOCIOLOGY

Direct Response (N = 126)	Frequency	*TV* Response (N = 119)	Frequency
		Favorable	
Sense of humor	41	Sense of humor	26
Interest	15	Interest	26
Friendliness	15	Friendliness	13
Enthusiasm	15	No comment	11
Warm and sincere	11	Interesting examples	8
No comment	11	Covers material well	6
Interesting examples	9	Enthusiasm	6
Understands students	8	Outlines lectures	5
Informal attitude	5	Good presentations	5
Puts students at ease	5	Frank manner	4
		Unfavorable	
No comment	33	Choice of language	23
Monotony	13	Too abstract or vague	13
Confusing	11	No comment	13
Goes too fast	9	Goes too fast	12
Uses unfamiliar terms	9	Wanders from subject	11
Choice of language	8	Biased	10
Too abstract or vague	7	Attitude toward religion	8
Hard to take notes	7	Doesn't follow text	5
Method of outlining poor	6	Monotony	5

The tabulations of students' favorable and unfavorable comments show considerable duplication of items under conditions of direct and televised teaching. The differences in the order of items as determined by the number of students who expressed similar ideas may suggest that students perceive some characteristics of teachers differently in directly-taught as compared with televised instructional situations. For example, under favorable comments, the first three items, sense of humor, interest and friendliness have the same order. However, sense of humor, was listed by 41 students (N = 126) in the conventional class and by 26 (N = 119) in the TV section. The item, warm and sincere, did not appear in the list of ten items mentioned most frequently with teaching over TV. The item, choice of language, appeared first in the list of unfavorable items for the TV section and sixth for the conventional class. However, monotony was second for the directly-taught students and tenth for those taught over television. Thus, we may conclude tentatively that students' perceptions and judgments about characteristics of teachers and teaching are somewhat affected by television.

MISCELLANEOUS OBSERVATIONS AND EVALUATIONS OF TELEVISED INSTRUCTION

Results from Air Force ROTC Interviews

In June of 1957 the Air Force Staff offered 1,113 freshmen cadets the following proposal:

(1) That plans were being made for Air Science II for the next year and consideration was being given to teaching the course both over television and in conventional classes.

(2) That it would be helpful to know how many students would prefer to register for the conventional classes.

(3) That students who did not want to take the course over television should report this at their convenience personally to the instructors in their offices.

By inviting the students to report if they didn't wish to take the course over television, the staff hoped it would be possible to determine what steps students would take to avoid TV instruction.

Only 14 students out of the total of 1,113 reported and requested to be assigned to a conventional class the next year. Only 4 of the 14 had had a course over television. Of the total, 230 freshmen had been taught at least one course over television.

Conduct of Students in TV Classrooms

Several attempts have been made to supplement general qualitative observations with systematic, quantitative observations of students' conduct in TV classes. Two observers using a prepared check sheet attended eight different courses during October 1956 in an effort to collect a recorded sampling of student classroom behavior and to prepare the groundwork for a systematic study.

The observers made suggestions for developing a suitable methodology: (1) There should be at least two observers, (2) Specific *acts* should be defined which could be tabulated and quantified, (3) The students should not be aware that they were being observed, hence a one-way vision screen or a small television camera should be used for observations, (4) Observations should be made and data collected both on TV and control classes, and (5) Accurate judgments about *degrees* of attention, interest and concentration would be extremely difficult to make.

On the basis of this preliminary study it is evident that the research on students' classroom behavior is a major project and could not be undertaken during 1956-1957.

The observers formulated several qualitative and tentative generalizations regarding classroom behavior of students:

(1) There is a close relationship between the TV teacher (how he behaves, and especially how he teaches) and the classroom conduct of students.

(2) The instructor may need to develop different techniques for TV teaching and for controlling or regulating the classroom learning behavior of students.

(3) Some proctors seem to have a good effect on the conduct and discipline of students while other proctors have an adverse effect. The latter type would come late, distract students, read newspaper and otherwise set poor examples for the class. (Note: The problems of defining the proper role of proctors and the best methods of selecting, training and supervising them deserve much more attention than has yet been given to these problems at Penn State.)

4. The observable classroom behavior of students may not be highly correlated with achievement in learning.

5. The kind of classroom behavior varies with the time of day.

6. The end-of-period restlessness may be stimulated by preliminary closing remarks of the teacher. Such behavior also relates to the necessity to be on time for a class in a remote building.

7. Attention and classroom behavior seem to be as favorable as in large conventional classes.

8. Students may need to learn new forms of behavior for TV classes which are not affected by traditional factors, including the presence of a teacher.

The systematic study of the TV classroom behavior of students remains to be accomplished.

Behavior of Students During Registration

The time of registration for courses provides an opportunity for observing students' reactions to being registered in TV courses. During the period of registration in the Fall Semester of 1955 an observer was assigned to the psychology desk for the purpose of observing and recording student reactions. These might be refusals to take the TV course, expressions of disappointment or of pleasure, requests to change sections or general inquiries from which inferences of attitudes could be made.

This procedure was not very productive. Only about 15 students out of the total of about 900 students who registered for General Psychology gave any indication of either favorable or unfavorable reactions toward being registered in the TV sections of the course. This, however, appears to be the significant finding: Even in 1955 and to a greater degree since then, students appear to accept televised courses on the same basis as other courses. The hour when the section is scheduled seems to weigh more heavily in the students' choice of sections than whether the teaching is given directly or by television.

As far as can be determined, the use of television in courses like psychology, sociology and music appreciation has not adversely affected registration in those courses. It is believed, subject to further analysis, that about the same proportion of students choose these courses as "free electives" when they are offered over TV as they did before the courses were televised.

Finally, it should be observed that students have not come to the point of demanding that they be registered in TV sections of courses. TV courses of outstanding quality may well be developed and, given time, the reputations of these sections may create strong student demand for them. There is no dependable evidence that this goal has yet been reached at Penn State.

Reactions of University Administrators, Trustees and the Public to Teaching by Television

The introduction and continuation of the Penn State TV Project has been strongly supported by administrators. It is believed that President Milton S. Eisenhower considered the Project among the major achievements of his administration of the University for the period 1950-1956. President Eric A. Walker, who proposed using television for teaching purposes 25 years ago, has given all necessary support to the Project. His main interests relate to television's feasibility and its potential for helping to solve the increasing enrollment problem. Also, he is especially interested in the possibilities of using television as a means of linking the University Park Campus with the Penn State Centers throughout the Commonwealth. The Vice President for Academic Affairs, Lawrence E. Dennis, has given the Project his personal and administrative support. He has worked closely, directly and effectively with all phases of the Project. He has exercised special care to keep all levels of the administration and members of the Board of Trustees informed of important developments and future prospects.

The TV Project at Penn State is a University-wide activity responsible to Mr. Dennis as Vice President for Academic Affairs. Therefore the role of college deans has been that of cooperating, approving and assenting to proposals and developments. None have opposed or obstructed developments. Generally they seem to have approved and encouraged experimentation with closed-circuit television and are beginning to accept its use as one means of discharging the heavy responsibilities which they carry for their colleges.

Department heads and chairmen who have had one or more courses televised seem satisfied and are willing to continue having appropriate courses taught over television. Department heads have generally supported their instructors and have made adjustments in work loads and schedules. Some department heads and chairmen have shown reluctance or resistance to having courses in their departments taught over television. In some cases, as in art and architecture and zoology, there were technical problems to be solved before television could be accepted. In other cases it appears that department administrators have not had adequate support from faculty members to venture into experimentation with television. However, the overall picture is favorable as indicated by the fact that every semester new courses and new departments are represented in the expanding television activity.

At present the Educational Policy Committee of the University Senate has a study committee which is reviewing the evidence collected and is formulating policy recommendations for action by the Senate.

The Board of Trustees has been kept informed of all aspects of the TV Project. During the academic year 1956-1957 fifteen members of the Board visited a TV class and made personal inquiries of professors and students about the Project. So far as is known, none of the Board have objected to or opposed the Project. On the contrary, members seem to have taken considerable pride and satisfaction in the fact that Penn State has taken a position of leadership in the development and use of closed-circuit television for teaching resident courses.

At Penn State the Board of Trustees represents the constituencies of the University as well as the Government of the Commonwealth.

When the TV Project was initiated in 1954, those responsible were concerned about possible negative reactions of the parents of students, especially in instances when students failed courses taught by television. No doubt some general reservations have been expressed to University officials but so far as is known there have been no specific protests from parents or members of the general public. Special efforts by University officials to keep the public informed, and especially the efforts of the Department of Public Information may account for the favorable climate of opinion in which the TV Project finds itself at Penn State.

A serious problem with which administrators are constantly confronted and with which they must contend is that incidental observations and spurious inferences based on them may determine the judgments and opinions of influencial people. In turn, these opinions and actions may have effects which outweigh masses of systematic objective evidence. It is the rare administrator who can accept criticism of his institution or of a non-traditional educational procedure and then weigh the criticism with balanced judgment against the evidence. Teaching by television does not escape from the dilemma of having its development influenced disproportionately by incidental criticisms of parents, students and faculty members.

Finally, it should be observed that although the administrators and the trustees have supported and have been favorable to instruction by television, nevertheless no unusual or forceful methods have been used to foster and sustain the project. A studied and cautious restraint was exercised in order to provide a normal setting for the Project in which its true merit could be tested. In addition it was considered important to provide conditions which would permit transfer of the Penn State results to other institutions without requiring them to introduce unique or unusual administrative procedures.

These brief descriptions characterize the attitudes of acceptance of instructional television by administrators, trustees and the general public. The future actions and decisions of the University Senate, the policy-forming and recommending body of the University, will probably determine whether or not the continued use of closed-circuit television will be officially accepted or rejected.

Observations, Suggestions and Critical Evaluations Made by an Observer Panel

Plans for the Penn State TV Project for 1955-1956 included, at the request of the Fund for the Advancement of Education, the use of an observer panel of educators. The panel was composed of selected, influential and competent men holding representative positions of responsibility closely related to higher education and its future development. Also, the panel consisted of men having varied backgrounds, interests and attitudes toward televised instruction. The purpose of the panel was the following: To provide external, objective, and constructive evaluations, suggestions and criticism of the Penn State TV Project and to acquaint panel members with its progress. The procedure used was to select members of the panel in consultation with the Fund for the Advancement of Education, to invite them to visit the TV Project at University Park, Pennsylvania for about two days, to provide each of them in turn with a full opportunity to observe televised classes and make inquiries about the Project. After the visit each member was invited to write a brief objective assessment of the entire activity. Each visitor was encouraged to express his best judgments, to be as critical as he wished and to propose changes and constructive suggestions.

The following educators and professional men accepted membership on the Panel:

Dr. Henry Chauncey, Educational Testing Service
Dr. John Folger, Southern Regional Educational Council
President J. Paul Leonard, San Francisco State College
Dr. D. G. Marquis, University of Michigan
President Harry K. Newburn, Educational Television & Radio Center
Dr. Gordon N. Ray, University of Illinois (Representing President David Henry)

Dr. Chauncey did not find it possible to arrange his schedule to permit his visiting Penn State. Dr. Marquis spent two days at Penn State but did not submit a report. Other individuals were invited but could not accept the proposed responsibility.

Reports were received from Dr. John Folger, President J. Paul Leonard, President Harry K. Newburn, and Dr. Gordon N. Ray, and are reproduced verbatim.

Comments of Dr. John Folger

Southern Regional Educational Council

June 4, 1956

One of the most interesting questions concerns *acceptability* of your research results. How can the project be organized so that sound research results can be translated into general institutional procedures? It would be presumptuous for me to suggest how this should be done at Penn State, but there are two general approaches to the problem.

One of the basic barriers to utilization of research in the instructional methods area is the prevailing conception that instruction is a private matter. As long as this point of view prevails, new instructional procedures must be sufficiently attractive or carry sufficiently attractive incentives to make college professors voluntarily adopt them. For example, if you paid teachers 50% more who adopted a new and superior teaching method, the innovation would probably be rapidly adopted. This is the first approach to research utilization. [Note: Bonuses have been given to outstanding TV instructors at Penn State.]*

The second approach would be to establish an organizational and administrative procedure for considering instructional research results. This would move the focus of decision

* Parenthetical phrases inserted by authors of this report.

making about instructional procedures away from the individual instructor to a committee, council, office, or some other organizational locus. This would provide the mechanism for considering research results from your project and making decisions about its implementation. [Note: See reference to University Senate, p. 88 of this chapter.]

I will be very interested to see what you are able to do about research utilization and hope that solutions at Penn State will help with this problem at other institutions.

A second general problem which interests me is the measurement of some of the non-achievement effects of television instruction. By this I mean the effects of television instruction on the general level of motivation to study of students and its effects on the choice of a college major and a career. It may be that TV has no very pronounced effect one way or the other on these variables, but this ought to be determined. Critics of classroom TV can say that you teach facts but you can't inspire people over TV. Some evidence needs to be accumulated on these points if you can figure out some way to measure motivation and inspiration. [Note: Much thought has been given to this problem.]

A third problem concerns the choice of experimental variables for study in your projects. Most of the variables introduced so far, such as class size and type of monitoring, have had no effect on achievement. You suggest that more sensitive tests should be developed. While this is certainly desirable, you may find that even if you can develop tests that produce significant differences, they will not be important differences. I would like to suggest that you try to measure the variables that *are* important in producing differences in learning without worrying about whether or not they can be used in TV experiments. How big are the differences in achievement of randomly selected sections of the class taught by 10 different instructors? How much difference is there in a single professor's section of a single class over several years time? If it turns out that most of the important variables are associated with the students rather than instructor or situation, you could improve the efficiency of your designs by abandoning the random selection of experimental and control classes, and try to select out of 1,000 students in a particular class, 50 that were homogeneous on variables associated with learning. Put 25 in the experimental group and 25 in the control group, thus reducing the within group variance and increasing the sensitivity of the experiments.

These are merely some alternatives to better tests which may have more significance for your experimental program in the long run.

Finally, I hope you will develop some experiment to evaluate the effectiveness of kinescoped courses as compared with live courses. These studies should include assessment of instructor reactions to, (a) himself on kinescope, (b) somebody else on kinescope. As I told you, one of our interests in instructional television is the idea of a network which could operate through distribution of kinescope prints. Any research on utilization of kinescopes as part or all of courses would be very valuable in assessing network feasibility. [Note: This problem is being investigated at Penn State.]

Comments of President J. Paul Leonard

San Francisco State College

May 11, 1956

On May 1-3 I visited Pennsylvania State University at the invitation of Mr. Carpenter, who asked that I serve as an observer to study the project in closed-circuit television in effect at the University. My host was Mr. Greenhill, who was very solicitous of my welfare, and made every attempt to acquaint me with the project in all of its aspects.

During the course of the visit I had an opportunity to observe on television courses in Psychology, Business Law, Sociology, Music Appreciation, Accounting and ROTC. I talked with the professors teaching the courses, with a number of other professors both on and off television, with the Provost and Assistant to the President, and with a number of technicians and operators. I studied the physical aspects of transmission, examined the experimental program, the tests, techniques of using the medium, and read the available printed, mimeographed, and typed reports of the results of the experiment.

The project at Pennsylvania State University is a very interesting one, under the direction of hardworking, serious, and devoted people. Obviously, there is considerable difference of opinion among the faculty about the experiment, ranging all the way from enthusiam to apathy and criticism. Certain members teaching the courses are still convinced in spite of test results to the contrary, that their own physical presence in the classroom raises the quality of student performance. Others are willing to grant that students learn as well through the medium as through normal lectures. Others are enthusiastic about the medium, believing it to be an aid to improving their instruction. Some have accepted it as they would the inevitable, in face of the imbalance pending between staff and students. In general, the majority of professors gave the attitude that they had set out to show the University that the project would fail.

But two results were obvious: (1) the professors were, with a few exceptions, working hard to teach a good course, and (2) the students were proving by every test they took that they learned as well from the television screen as from the visible classroom presence of the instructor. The absence of questioning seemed to make no difference, and conditions were not especially good for learning. The rooms were dark, unattractive, uncomfortable; the cameras took pictures of a professor teaching in a room rather than of a faculty member teaching directly at individual viewers; and only a small amount of actual visual or novel ideas or materials were used. [Note: As reported in this Report, much effort has been made at Penn State to adapt courses to TV since President Leonard's visit.]

The one reaction that was supported by repeated experience here, and by knowledge of other experiments, was that as far as college age youth were concerned, they could do as well on regularly prepared tests by taking the courses taught over television as by taking them in small groups through direct personal classroom contact with the professor. If these findings are generally supported elsewhere, television

is here to stay as a very valuable aid to college instruction and as a means of meeting the shortage of teachers. If properly utilized, the medium can provide enrichment and diversity as well; and if circuits are open and distractions are not too great, the same instruction can serve many needs. Television is here to stay and we should learn to use it.

The experiment at Pennsylvania State has proved that pupils do about the same on regular tests whether they see the professor in the class or over television in another classroom. And this is the basic motivating purpose of the experiment. Some valuable experimentation has been done with the Dage television equipment which will help us all.

Certain suggestions are made which are the result of the observation, with due modesty for the element of error from judgment and knowledge gained only from a full two-day visit. These suggestions and observations are made with the desire to improve the project which the writer hopes will be even more successful.

1. The administration of the University is reported to be very hospitable to the ideas of the experiment, but judging from conversations with professors this attitude does not seem to have reached the general faculty level. There is some fear on the part of the faculty regarding their position and welfare, and misunderstanding over the future place and purpose of television in the University. Additional efforts should be made to communicate the administration's viewpoint and interest in the experiment to the faculty. It is beleived that this may lead to a better acceptance of the project on the part of some of the faculty members. [Note: See description, pp. 88-89 in this chapter, of roles and attitudes of administrators.]

2. More exploitation of the television medium is needed. Insufficient aid and assistance are available to the faculty for visualization, and the faculty has too little inclination to use even what is available. Ideas and acceptance are mutual attitudes here, and both seem to be unsatisfactorily developed. If the medium is really to serve, full advantage should be taken of its power and flexibility. When this is done the results may be even much greater in favor of the group using television. Furthermore, some of the faculty need to improve their lectures.

3. The use of the camera in the classroom where both students and professors are at work mitigates considerably against the successful and flexible use of the camera for projection. The image also is like a news reel of an event, rather than an interview. The professor before the camera, talking to each individual through the camera, produces a different and more highly personalized image than the view of the classroom teaching. The traditional ego of the professor, stimulated greatly by rows of youthful faces, prevents him from transferring to the studio, but if the medium is used to its full advantage, either the professor should move to the studio or much work should be done by the production man to improve the personal touch of the screen. Some shots are no better than radio transmission. [Note: The transfer of TV cameras from a classroom to originating room has been accomplished at Penn State.]

4. At Pennsylvania State, the professors have full responsibility without much aid for the content and methods of the courses. Essentially this is sound as long as the basic purposes of the course and the University are being served, but instruction could be greatly improved if (a) some plan could be solved where professors could see and hear themselves lecture a few times; (b) studies were made of effective and ineffective methods and plans of organization and presentation; (c) production men could help the professors use the medium more skillfully; (d) improved use of visual aids and out of classroom experiences could be injected. Seriously, with the experiment merely showing conventional classes being taught, the results of the experiment are even more amazing than they would be if the medium were more fully used. [Note: See Chapter III of this report on Appropriateness.]

5. There should be more unity of instructional leadership emanating from the offices of the Deans for the entire teaching aspect of the experiment. One got the feeling that the experiment was more a collection of discrete professors operating as individuals than as an experimental team bent on a venture. Appropriate relief commensurate with the increased load should, also, be given the faculty. Plans for teaching, testing, experimental procedures, tapes, kinescopes, visits, and periods of discussion among the faculty would doubtless improve the quality of the program. The television shows clearly the futility of the textbook being reviewed in class by the professor, or of dull or monotonous presentation. Some leadership needs to be taken in an honest experiment in science. The present use of the screens in the large Science lecture room proves nothing of worth in the experiment and shows the lack of the experimental attitude applied to methods and presentation in a field which depends upon this attitude for progress.

6. More work needs to be done on the techniques of the medium, such as (a) clarity of sound and voice; (b) the photographing of visual material; (c) the ventilation and sound control of rooms; (d) use of blackboard; and (e) position before camera. [Note: Considerable improvement has been made in technical performance of equipment as well as camera and control techniques at Penn State. A new Dage 320 system has made some improvements possible.]

Comments of President Harry K. Newburn

The Educational Television and Radio Center

April 13, 1956

I Basis of Observations

The following observations are based on a visit to Pennsylvania State University which covered parts of two days—Tuesday and Wednesday, April 10 and 11. The observations are based on visits to Music 5 taught by Wareham, Air Science taught by Captain Aikens, Commerce 30 taught by Tanner, and Psychology 2 Section 2 taught by Slivinske. In addition, I talked with all of the above persons, except Aikens, plus A. H. Reede, who teaches Principles of Econom-

ics course, the audio-visual man who teaches the Introductory Education course, and the History of Architecture man who is interested in combining oral presentation with architectural sketches. I also talked with the Provost, the President, and with members of the Education staff, in addition to Dr. Carpenter and Mr. Greenhill. The visit was limited in time and extent, and the remarks which are made later in this statement should be conditioned by this fact.

II General Setting

Physical

I was impressed with the physical setting. In the first place, the directors of the project decided to keep the equipment simple, flexible, easy to operate and relatively inexpensive in original cost and maintenance. The building changes have been kept to a minimum consistent with adequate use of the equipment and adequate control of acoustics. The classroom changes are minor in nature and are limited to providing adequate connections for the television equipment and adequate lighting to maintain an appropriate picture. The technical quality which results is very good. I was impressed with the quality of the picture and with the camera coverage. The separate sound system has improved materially the quality of the sound which is delivered to each of the classrooms.

Intellectual

The approach to the project is experimental and objective. The people involved are open-minded and there is no evidence of a defensive attitude existing in connection with the project. Visitation and observation are encouraged and there is no tendency to withhold information or defend in any way activities toward which observers might become critical. The attitude of the teaching staff also is very good. The participants with whom I discussed the teaching activities seem to be quite enthusiastic about the program and very much interested in its success. They also seem to accept the objective approach which exists at the planning level and consequently speak freely and critically of those items which seem to them to need improvement, as well as the difficulties they are facing in connection with the project.

It would be easy in such a program to become overenthusiastic or to anticipate too much the outcomes which are desired. There is no evidence of such an attitude, either on the part of the administrators or those who are doing the actual teaching. In some cases, the teachers have continued their teaching activities much as always. In others, the instructors have modified their methods to take advantage of the use of visuals and other television techniques. All along the way I was impressed with the manner in which the atmosphere was maintained on a free and voluntary, nevertheless experimental, basis. This will lead to a more intelligent and constructive reaction on the part of those staff members who are now engaged in the project and who in some cases undoubtedly are negative or at least dubious about the use of television for educational purposes.

III Informal Generalizations

The design of the experiments and the approach to the project are intelligently conceived and are so conceived as to make it possible to adapt to developing needs and opportunities. To date, the project has been confined largely to basic, broad elements of experimentation, under the assumption that these need to be brought under control first and before refinements come. The leadership has tended to accept things as they are and to adapt the experimentation and controls to the realities. In the beginning, as I understand the situation, it was assumed that the classes would be taught by television just as they had been taught before television. However, as the experiment developed, it became clear that this could not be continued and consequently, wherever possible, full advantage has been taken of the opportunity to adapt instruction to television and thus take advantage of anticipated improvements thus possible. The approach is not unduly enthusiastic or biased and there is no tendency to prejudge in any sense the experimental data. The direction of the project is in the hands of people who, while they personally believe that television has much to offer, are not permitting this attitude to affect their judgment in advance of the data which they are collecting. The program is more comprehensive in approach than anything being conducted elsewhere of which I am aware.

One of the things which impressed me greatly and which I had not anticipated, is the degree to which this project is stimulating and will continue to stimulate a comprehensive analysis of the teaching act, and consequently the improvement of teaching generally. There is considerable evidence that as people observe their own teaching and as their colleagues view it, many are beginning to think more critically of what they are doing, why they are doing it, and what the results are likely to be. This attitudinal change can become one of the major results of such a venture even though it was not intended primarily to produce such outcomes. Anything which encourages a critical analysis of the process of teaching will enliven and make more dynamic the total teaching situation. The evidence of self-analysis was widespread, and the stimulation of such self-evaluation can be most meaningful to the institution.

I believe one of the most interesting areas for concentrated investigation during the next year is that relating to student interest, attention and attitudes. As one observes both in the small sections and in the large auditorium, he becomes aware of evidence of inattention, lack of interest and possible indifference which *seem* to exist on the part of numbers of students. I say "seem to exist" since it is entirely possible that the overt indications are not actually real. It would seem that a number of studies should be conceived and carried out during ensuing months to secure some measures of the true interest level, as well as those relating to attention and general attitude. While something of this sort is planned, I think it might well be given heavy emphasis. Many of the discussions with the television teachers indicate that they are somewhat disturbed about the lack of control which they can exert over the classes and the consequent lack of interest

or attention which *may* be developing. Some have developed techniques designed to cope with this situation to some degree, but they seem to think of it as a continuing problem. The control is certainly informal and freer than the typical classroom situation. Whether this is good or bad needs to be determined, and it can only be determined by setting up a number of specific efforts to study various aspects of the problem. I would suggest heavy emphasis on this aspect of the project in the immediate future. [Note: See pp. 87-88 of this chapter on classroom behavior of students. However, a systematic attack on this problem has not yet been made.]

Another area which needs clarification and which is quite important is that involving personal contact of the television teacher with his students. This also is a factor which was mentioned by a number of the teachers and one which bothers them considerably. Efforts have been made by some instructors to overcome the lack of personal contact which results from teaching a large group by television in a number of sections, but there is much yet to be done. I believe these efforts should proceed in two directions. In the first place, as was suggested by Professor Marquis, a very definite effort could be made to strengthen the relationship of the students to the graduate assistants who are assigned to the various subdivisions. If the students could begin to attach themselves to the graduate assistant responsible for the section, and if this person could be thought of by the students as their teacher, this in itself would tend to overcome (from the student point of view) some of the objection to the lack of personal contact with the professor. However, I agree with one of the TV teachers that the students want personal associations with the lecturer himself. The second type of approach, therefore, should involve various experimental efforts to bring the students into closer personal contact with the major instructor of the course. What can be done to relate the instructor more personally to the student? I should think there might be a number of approaches to this problem, depending upon the future of education by television, and if there are ways to eliminate the obvious weaknesses and provide for the needs involving personal association between student and teacher, this would be extremely useful to the developing movement. [Note: This remains an unsolved problem.]

I have always been interested in the lack of student participation in the educational process at the college level. This is not confined to television classes by any means, but, nevertheless, it is extremely important. There appears to be a tendency in televised instruction to carry on the tradition of the past to pay relatively little attention to active student participation in the learning process. This will be criticized very severely and pointed to as a weakness peculiar to television. Even though the differences between television teaching and regular classroom teaching are insignificant in this sense, the arguments against television teaching will certainly involve this element of lack of student participation. The teachers observed are making some effort to secure student participation but much more could be done on a systematic basis. These efforts also might take two directions. The first and most obvious approach is to combine lecturing by television with non-televised discussion in the individual classrooms, conducted either by the television teacher or by his assistants. This may well be an appropriate method of handling the situation. On the other hand, I hope that efforts to study student participation will not be confined to the non-television aspects of the program. I believe that the lecturer himself should attempt to develop ways of bringing all the various sections into an active participating relationship *during the televised portion of the teaching act.* Such participation not only would affect the performance and achievement of students but their morale and general attitude as well. Tanner uses the technique of asking questions which are answered by those immediately before him but which didn't seem to encourage participation in the sections. This is one approach. The use of pictures to demonstrate various kinds of emotion in the psychology class, and the use of recordings in the music class, represent other efforts. In other cases, it is clear that the students are not participating effectively and the whole problem needs study and analysis.

I would suggest that you plan with the various instructors to include in the presentation a variety of efforts designed to encourage student participation. This factor might well be related to attention and interest on the part of students. It represents another area which should have considerable emphasis in the months ahead.

There's no question in my mind but what the experimental work should continue, not only for another year but indefinitely. I presume that during the next year some of the broader experimental efforts can be refined and the project can be pointed more specifically toward efforts designed to answer specific questions which in turn can be integrated into answers to some of the broad issues involved. I presume that gradually the outside financial support will be reduced and the University will maintain the continuing experimental work, just as it is now expecting to maintain those activities which are of a general operational character. This suggests that the University should begin to assume immediately a greater portion of the cost in anticipation of future responsibilities. I should not worry if general operational adaptations were continued and broadened during the period which will be primarily experimental in nature. Certainly University personnel are showing a great deal of ingenuity in adapting closed-circuit television to a number and variety of educational uses. This activity should be encouraged and supported on every hand. [Note: Penn State began contributing directly to the cost of the Project in 1956-1957.]

I presume the University will ussume responsibility to publish and disseminate the results of the experimentation widely. A project as comprehensive and intelligently designed as this will attract much attention and there will be heavy demand for a comprehensive report of findings on the part of a large and interested audience. In addition to the general publications the University should publish specific bulletins on the variety of uses of closed-circuit television which are being made by various faculty members. Their various adaptations, entirely apart from full time use of TV for classroom teaching, are exciting and demonstrate realistically the great potential of the medium. [Note: About 5,000 copies of Report Number One, "An Investigation of Closed-Circuit Television for Teaching University Courses," were distributed. A similar number of the present report will be printed.]

I was impressed during the visit with the total climate in which the project operates and with the manner in which it is being conducted. It will provide important and meaningful data for those seriously interested in adapting this new medium to the education of our people.

Comments of Dr. Gordon N. Ray

Department of English, University of Illinois

March 27, 1957

In your letter of 22 February formally inviting me to serve as President David Henry's replacement on an Observer Panel formed to survey the Pennsylvania State University Instructional Television Project, you suggested that I come to University Park in order to examine all phases of your undertaking and afterwards send you a summary of my observations and interpretations. Having visited you on 19-20 March, I now send the requested summary.

Let me promise that I came as a somewhat skeptical outsider, whose information about closed-circuit television for educational purposes was derived chiefly from various printed materials emanating from the Pennsylvania State Project. From the first I thought it unlikely that I should have any ideas to communicate that would not have occurred long since to those who had been working for eighteen months on the Project. This assumption has been confirmed. I can offer instead merely an account of how I was impressed by what I saw and heard.

The excellent printed descriptions of your operations had led me to expect an efficient and smoothly running enterprise, and this expectation was amply borne out. The moderate tone and careful documentation of these publications had encouraged me to think that the claims made in them would be substantiated, and here too I was not deceived. But what struck me most forcibly about your program was the ease, informality, and the smoothness with which it is run. High pressure methods are carefully eschewed. Faculty participation is on a voluntary basis. Everything is done to adapt television to the existing teaching situation. Students and faculty alike are left free to form unhurried, undirected opinions regarding the usefulness of closed-circuit television in education. All this was in pleasing contrast to the situation prevailing at another university I had visited, where considerable faculty resentment and resistance had been built up by administrative efforts to tailor teaching methods to what were conceived to be the demands of the television medium. [Note: Contrast with President Leonard's observations and recommendations.]

But though I quickly saw that closed-circuit television is being tested under very favorable conditions at Pennsylvania State, I continue to believe that it can only be regarded as a *pis aller*, except when employed as an auxiliary in classes taught by traditional methods. As you have pointed out yourself again and again, where the student or faculty member can choose between traditional and televised instruction, he will invariably choose the former, *other conditions being equal.* [Note: Size of class is a variable in this preference.] All the arguments brought against closed-circuit television on the ground that it further separates teacher and student are unanswerable; and we cannot too often reiterate, with Newman a hundred years ago, that ideally a university should be "an Alma Mater, knowing her children one by one, not a foundry, or a mint, or a treadmill." Unhappily in many colleges and universities today, this sort of personal association is hard to achieve, and in some cases it will become almost impossible to encompass in the near future. Very opulent institutions which can effectively restrict enrollments may be able to adhere entirely to traditional teaching methods. The rest of us will have to find the best available means of dealing with greatly enlarged student-bodies on limited budgets. It is here, *as other conditions cease to be equal,* that closed-circuit television can be expected to prove its substantial usefulness. As one of your publications puts it, "Closed-Circuit TV Is One Answer." It seems to be desirable, therefore, that all major universities with pressing enrollment problems take steps to discover for themselves the extent to which this answer is applicable to themselves.

The most interesting result that may be anticipated from such experiments, it seems to me, is one which at first glance may seem peripheral, *a renewed interest on the part of the faculty in the art of teaching.* Certainly no one can visit classrooms using television for two days, as I did, without thinking a good deal about the whole subject of teaching. To watch such gifted, experienced, and idiosyncratic instructors as Professors Coutu, Reede, and Tanner—and by closed-circuit television one can do this in a perfectly neutral and unembarrassed way—, is to have one's assumptions and perhaps prejudices concerning teaching shaken up in a very salutary way. To compare their work with that of less talented and adroit instructors is to see how wide is the gap between good and mediocre teaching and how necessary it is that the urge for self-improvement in teaching be cultivated by our faculties.

I am very strongly of the opinion that funds should be provided to continue the Instructional Television Project at Pennsylvania State University until the University itself is financially able to assume full financial responsibility for this project. You are in mid-stream with regard to many interesting matters: the medium's adaptability to various subjects (as yet English and mathematics, for example, have not been attempted), its adaptability to courses of some intellectual complexity(as yet only elementary instruction, necessarily presented in a broad, even florid fashion, has been tried out), student and faculty acceptance of the medium, the transition from subsidization through outside funds to the use of regularly budgeted university funds with all the delicate faculty and administrative adjustments that this transition necessitates, etc. The patterns established by the Pennsylvania State University in these and many other matters will be of great use in guiding the experiments of other institutions of higher learning.

These observations, criticisms and suggestions have contributed much of value to the development of the Penn State TV Project. The procedure of using an observer panel with members making independent observations and reports permitted full individual expressions and judgments. The variations among these as well as the agreements are both interesting and important. The reports of the observer panel members provided those at Penn State with some external criteria for assessing their work. It is possible also that these reports were useful to the Fund for the Advancement of Education as relatively unbiased judgments of the soundness of the Project and its possibilities.

5—Feasibility

Introduction

The question of feasibility or the practical considerations of teaching by television are dealt with in this section. In previous sections the problems of comparative effectiveness, appropriateness and acceptance of television have been defined and the relevant data presented. It is suggested that in order to ensure the success of an instructional television operation a minimum standard of performance must be reached in all four of the areas of effectiveness, appropriateness, acceptability and feasibility, otherwise the project will fail. Step by step each area must be evaluated. Teaching by television could be very effective, entirely appropriate and well accepted and yet not succeed unless the activity is feasible. Therefore, it is very important, in this final section to assess the general feasibility of teaching by TV as exemplified by the Penn State Project.

The assessment of feasibility requires answers to many important questions: Are the vidicon types or models of equipment practical? Are the systems sufficiently dependable for regular full scale operation? What is the most practical and satisfactory method of distributing instruction to classrooms and buildings? Can the systems be operated regularly by personnel usually available in colleges and universities? Is it practical to coordinate activities of televising instruction with the regular and demanding tasks of teaching, and if so, how can this be done? What practical uses can be made of student assistants in teaching by television? How is it possible to conduct and coordinate research work with regular instruction? Finally, what are the costs and how do they compare with the costs of conventional teaching procedures? An attempt will be made to answer these and related questions in this section of the report.

Feasibility of Vidicon TV Systems

A major problem of feasibility relates to the general adequacy of vidicon television systems, and to the practicality of staffing and operating such equipment within the context of a university.

During the 1956-1957 academic year, five closed-circuit television systems were in use at Penn State:

(1) a professional dual camera chain Dage model 320 with facilities for televising motion pictures and slides.

(2) a dual camera chain Dage model 300. This is the earlier model of the Dage professional vidicon system that was purchased for use at the beginning of the Penn State TV Project in 1954.

Both of the above camera chains were installed in the Liberal Arts Building and were operated from the same control room. They could be used separately or simultaneously.

(3) a Dage model 101 junior professional camera. This was used in chemistry for magnifying demonstrations, and in metallurgy in conjunction with the metallograph for presenting magnified metallic specimens.

(4) a Dage model 60B industrial TV camera. This was used in a large classroom in the Electrical Engineering Building for magnifying small items of equipment, the details of schematics, and a model slide rule.

(5) a Dage model 60A industrial camera. This was used in the Speech Department for the remote observation of teaching and especially of the speaking performances of students.

In addition, a relatively low-cost Dage kinescope recorder model KR-11 was obtained and used for the production of recordings of instruction on 16mm sound film.

In 1954 when the Penn State TV Project was begun it was decided to use vidicon television cameras largely because of the anticipated relative economy. It was believed that entirely new possibilities for the use of television in education would develop if this type of equipment should prove to be dependable and practical and would provide pictures of adequate quality. At that time there was considerable doubt about the adequacy of this type of equipment for televising instruction.

Subsequent experience has dispelled this doubt. The various types of vidicon television equipment now available are entirely satisfactory for closed-circuit educational uses as well as for educational broadcasting, kinescope recording, presentation of motion picture films and slides, magnification of demonstrations and observations of remote events. All of these applications have been tested and proven at Penn State.

It should be pointed out that considerable improvements in the recent models of vidicon cameras have been made during the past year and a half. As a result of experience with earlier model equipment, it was possible for the Project staff to make a number of suggestions to the Dage Company that have been incorporated into the present models of equipment. Furthermore, suggestions for the production of new types of equipment have been accepted. For example, the production of the relatively low-cost kinescope recorder (which records television programs on 16mm film) was undertaken in response to proposals made by the Penn State television personnel. This recorder was built, tested, modified, re-tested and is now performing very satisfactorily.

The five television systems at Penn State have proven to be very dependable in operation. With most new electronic equipment, an unstable period of about two or three months following installation should be anticipated. During this period the equipment requires considerable engineering attention but it then becomes stable and gives reliable service. The most common form of trouble frequently results from new vacuum tubes that become defective when first used and need to be replaced. The necessity for good television

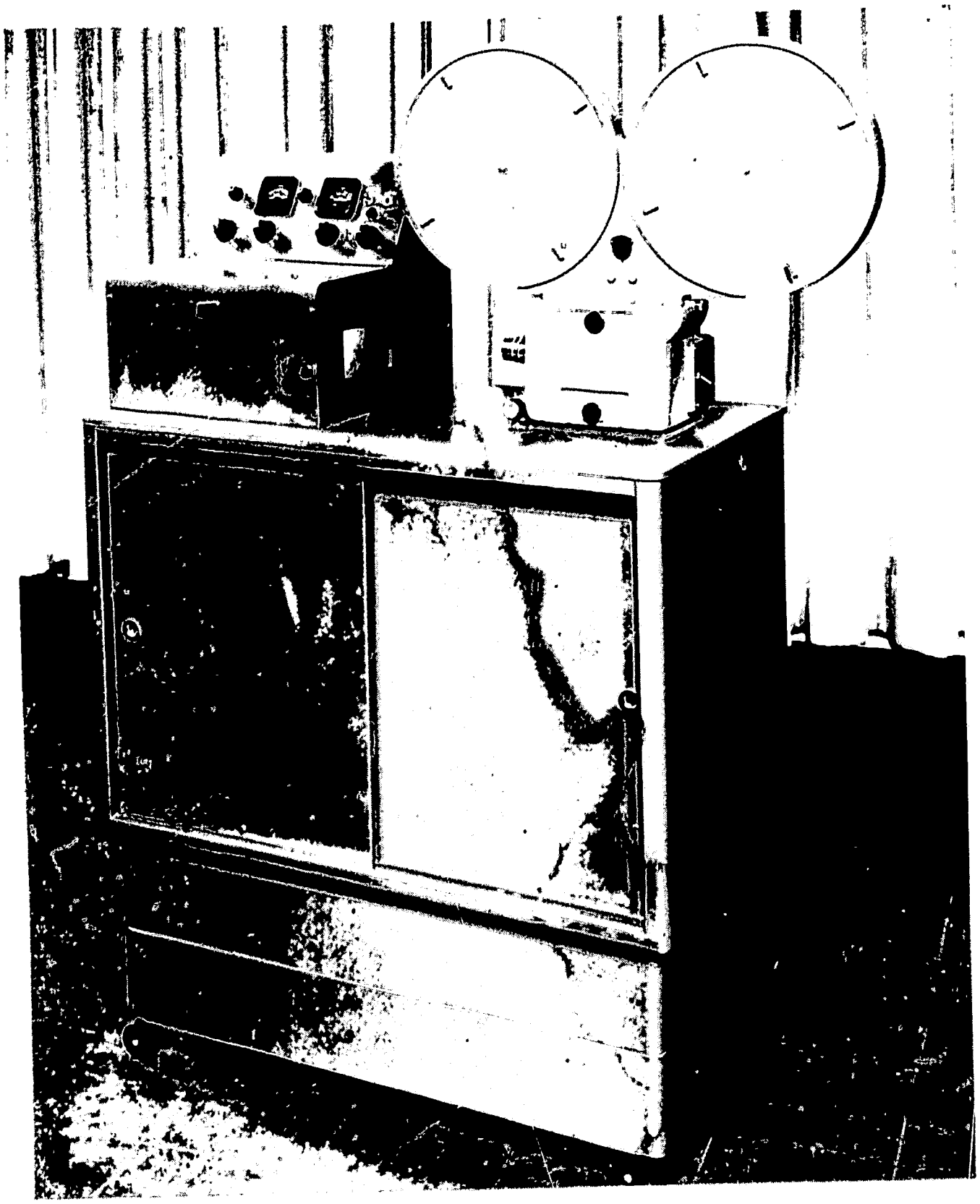


FIGURE 10. PORTABLE DAGE KINESCOPE RECORDER DEVELOPED FOR PENN STATE TV PROJECT

engineering services should not be underestimated. These services can make the difference between a dependable and an unreliable operation.

Generally the more complex the television system, the more demanding are the engineering maintenance requirements. Thus the professional systems demand a higher level of engineering competence than the junior professional and industrial types, and the lowest cost industrial vidicon system makes the least demand on engineering maintenance skills.

During 1956-1957 the Dage 320 dual camera chain was in operation for between thirty and forty hours per week over a period of some thirty weeks—approximately 1,072 hours of operation. During this time there were only four occasions when a televised presentation or part of a program was completely lost because of TV equipment failures. On six other occasions part of a TV presentation was lost because of temporary failure of power on the main line due to overloaded circuit breakers.

There were a number of occasions during the year when a tube failure, minor component failures or loose connections put a camera out of action for short periods or produced a "noisy" operation. Generally, these problems were quickly solved, and did not result in an interruption of classes.

Similarly, the Dage models 101 and 60B cameras which had considerable service in chemistry and engineering proved

to be very dependable in operation. This is not only a credit to the design of the equipment, but also to the diligence and skills of the student engineers who installed and maintained these television systems.

The Penn State TV Project has shown that vidicon TV systems are entirely practical for closed-circuit use in a university. The feasibility of using the 320 system for broadcasting and for producing kinescopic recordings was established following the period covered by this report. The details of these developments will be given in subsequent reports.

Practical Considerations Relative to the Installation and Operation of TV Systems

Institutions which plan to use television for teaching will generally have the alternatives of installing systems in existing buildings or in new classroom buildings. Until now, TV installations have been made at Penn State in existing buildings and these have been done with minimum building modifications. Rather typical classrooms and lecture halls have been used although these rooms were not ideal for television. Regular classroom space was converted to an originating room. A storage room occupied also by an on-campus FM radio transmitter was used as a control room. A small closet formerly used for janitorial supplies was used for spare parts, equipment and supply storage. Since adequate conduits were not available the running of cables was difficult and required drilling through concrete or tile walls as well as the cutting of cable channels in concrete floors. The main supply of power was inadequate and had to be increased. New switch boxes, breakers and larger mains cables had to be installed. Exhaust fans were needed in the control room to reduce temperature levels to avoid the overheating of equipment. Wherever programs were originated, lighting equipment had to be installed. In the main originating room for the 320 camera system in Sparks Building, temperature levels often rose beyond the point of comfort for instructors. Air conditioning was needed but has not been installed.

It can be inferred from these facts that the Penn State TV Project has operated under rather austere conditions and with many practical physical handicaps. Since these conditions are probably typical of those which exist in most colleges and universities planning to use television for teaching, it is important to note that installation and operation of TV systems under far from optimum conditions have been demonstrated to be entirely possible.

Most of the adverse conditions which now prevail for installing and operating TV systems can be eliminated by careful architectural design of new classroom buildings. Adequate electrical power where it may be needed should be provided. There should be entirely adequate duct space for cables and wiring. Provision should be made for all necessary electrical switching, patch panels, connections and outlets. Control and originating rooms should be designed for their special functions. A room should be provided for parts storage and engineering maintenance. Space should be made available for the preparation and storage of instructional materials and equipment. Special attention should be given by architects to problems of ventilation, lighting and acoustics in originating rooms as well as in classrooms. Thus, it can be seen that advanced building planning to provide the basic essentials for installing and operating TV systems for instruction can contribute greatly to solving problems of practicality and feasibility. It is probably fair to say that most college and university classroom buildings now being designed for large campuses should be planned and constructed to provide for the possible use of television in instructional programs.

Comparisons of Distribution Systems

Two main systems are possible for transmitting television signals from cameras to receivers over coaxial cable. These are known as video frequency (video) and radio frequency (RF). Video refers to the picture signal as it comes from the switching unit. It contains picture information and synchronizing pulses. Such a signal can be fed directly into a video monitor to produce a picture, or into an especially modified receiver in which the signal is fed directly to the video amplifier stage. The sound is transmitted on a separate cable to loudspeakers in the classrooms.

Most receivers are designed for a radio frequency signal (RF). In order to supply an RF signal, the video picture signal from the TV switching unit and the audio frequency from the audio console are fed into a "mixer" or "modulator" which mixes and superimposes them on a radio frequency carrier wave. This is then transmitted over the coaxial cable passing into the tuner of the receiver where it is separated again into its video and audio components to produce both picture and sound in the receiver. Generally, one of the broadcast channels 2 through 6 is selected as the frequency for transmission of the RF signal.

From the practical point of view it can be said that video distribution offers the advantage of high picture quality and ease of distribution over short distances. However, it may present problems if there are many different rooms to be served. Furthermore, only one program at a time can be sent on one coaxial cable. However, with a well designed system and with good quality video monitors in the classroom, there should be no difficulty in obtaining 500 line resolution.

RF distribution has the advantage of easy transmission over long distances; the signals can be amplified as necessary; picture and sound are transmitted simultaneously over the same cable and the system is simple to expand, thus making it easy to add additional rooms. Furthermore, several programs can be transmitted at the same time on one cable by using different frequency channels. These are selected merely by tuning the receiver to the appropriate channel. This means that standard unmodified receivers can be used. Generally, the amount of resolution in an RF system is limited by the design of the receiver. Since most regular receivers are

designed to pass a narrower band of frequencies than a video monitor, their resolution is usually lower. In a good RF closed-circuit situation, 350 line resolution should be obtainable and this is adequate for many or most instructional applications.

Penn State Video Systems

The original installations at Penn State used video distribution systems for the pictures and RF distribution for the sound. In this system the receivers were connected in series on one cable which was terminated at the last receiver on the cable run. The receivers were modified to accept a video picture signal. The audio signal was fed through an RF modulator and transmitted over the same line with the picture signal.

This system was found to have several defects:

(1) The picture was apt to be weak toward the far end of the line.

(2) If any receiver in any room was disconnected, it put all receivers out of action.

(3) Line reflections gave ghost images. These resulted from having a large number of receivers in series on one line.

(4) The use of the regular sound systems and speakers in the receivers were generally inadequate for classroom use (the receivers had 5" speakers mounted in the *side* of their cabinets.)

Prior to the beginning of the Fall Semester of 1955 the picture distribution and audio systems were redesigned.

A graduate student in the Electrical Engineering Department designed and constructed a video distribution amplifier with ten output connections. This amplifier accepted the video signal from the TV switching unit, amplified it, and transmitted it over separate coaxial cables to each of seven classrooms. Within a given classroom two or more receivers might be connected in series and the line terminated at the last receiver in the room.

A new audio system was designed with a separate audio cable to each classroom where the signal was fed into a "folded horn" type of enclosure equipped with a high quality 12' speaker (the Electro Voice Aristocrat). This audio system was designed especially to provide high quality audio for the course in Music Appreciation.

The redesigned distribution system resulted in improved quality of both picture and sound. It should be noted, however, that the resolution of the picture was limited to about 350 lines because standard (but slightly modified) receivers were used rather than special video monitors. It will be realized that such a system, involving separate cables to each room, could become cumbersome if many rooms in a building were to be served by the television system. The system would be impractical for distributing several programs simultaneously.

Accordingly, when the need came to expand the system in the Liberal Arts Building for the Fall Semester of 1956, it was decided to serve the additional eleven rooms by means of an RF distribution system. This system was designed by a local engineering company.[1]

A video output from the camera switching unit and an audio line from the audio console were fed into an audio-video mixer which transmitted an RF signal on a coaxial cable. At the far end of the building this signal was passed through an amplifier and then at each of the eleven additional classrooms a line was tapped off from the main coaxial cable and fed through a small transformer directly to the antenna terminals of the classroom receiver. The system was so designed that a signal of the proper strength reached all of the receivers, and each receiver was isolated so that a failure in it would not affect other receivers. The quality of the audio of the regular 24" receivers was improved by providing an 8" speaker mounted on a suitable baffle on the front of each receiver stand.

The system also permitted signals from the three audio-video mixers which were available, to be fed into the same coaxial cable on different channels (channels 2, 4, 6) simultaneously. Such an arrangement permitted comparisons between the video and RF methods of distribution, and between several kinds of audio-video mixers. The additional mixers provided a safety factor in the event of a failure of any one of them.

The picture quality obtained was quite acceptable. The contrast was adequate and the resolution (350 lines on RETMA Test Chart) was only slightly less than that obtained with the video distribution system. The sound, though not as good as that produced by the special audio system with high fidelity speakers, was adequate when the receivers were properly adjusted.

It should be reported that both picture and sound must be carefully tuned-in on the receivers when the RF system is used. The tuner is by-passed in the video distribution system, and tuning is not necessary. The signals on the three RF channels, 2, 4, and 6, could be selected at will and there appeared to be no inter-channel interference.

In summary, it can be said that where strict economy is not of primary importance, where a few rooms fairly close to the point of origin are to be served, and where high resolution is desired, the video distribution system is recommended. High quality video monitors rather than modified receivers should be used to take full advantage of the high resolution characteristics of the TV system.

Where an extensive installation is planned with rooms located on several floors, or perhaps in several buildings on a campus, where 350 line resolution is adequate, where the economy of cost is an important factor, and where the possible need to transmit several programs simultaneously exists, the RF system is recommended.

A new TV installation which is being planned at Penn State to serve at least thirty-three classrooms, with later expansion to other rooms and buildings, will use an RF distribution system.

1 Community Engineering Corp. of State College, Pennsylvania.

Operating Personnel

Another aspect of feasibility relates to the question of whether it is practical in the operation of closed-circuit TV systems to use students and staff members who are available at a university rather than to employ professional people from outside the university.

The answer to this question depends, of course, on the kinds of people who are available. Penn State was fortunate in having people who could meet most of the varied requirements. It was decided as a matter of policy that whenever it was practical to do so, students would be employed in the operation because of its possible training value for them and because of the implications for other universities where closed-circuit television might be used.

Student Camera Operators

During 1955-1957 students were used exclusively for operating the TV cameras. Many of the students were majors in speech or drama and had taken one or more courses in television, but many other departments were also represented. Students who were interested were invited to contact the staff member who coordinated the TV operations. They were given some training and were appointed for a five weeks' trial period. If this trial period indicated that the student had aptitude for the job and was dependable (a most important requirement) he or she was permanently appointed for the semester. Most student camera operators worked three to six hours per week. They were paid 75¢ per hour after completion of the probationary period. Generally, with few exceptions, their performance proved to be very satisfactory and also many students received important training. They earned income and yet costs to the TV Project were low.

Student Engineers

Good engineering sevices are essential to an efficient television operation. At Penn State student engineers have installed television equipment, designed and built special equipment, provided maintenance and trouble-shooting services, and have set up and checked the receivers for daily classroom operation.

The University was fortunate in having available a number of students who had a special interest in TV engineering and who had backgrounds in radio or radar. Most of these students were majors in electrical engineering. Two of them were graduate students in this field. Several of them were very experienced; others were less experienced. For most of the two-year period covered by this report an experienced undergraduate student carried the assignment of Chief TV Engineer. He organized the engineering staff and scheduled and supervised the work of other student engineers.

A good deal of on-the-job training was given and it was possible to arrange for several of the most advanced student engineers to spend periods of time at the factory of the TV equipment manufacturer.

The student engineers all worked for the TV Project on a part-time basis and were paid at rates ranging from 80¢ to $1.50 per hour depending on experience.

It can be said that these students performed an excellent service, often under difficulties. The greatest of the difficulties was a lack of time since the student engineers carried heavy course loads. This became an increasing problem as several of these students reached the senior year of college, and care had to be exercised to ensure that the demands of the TV Project did not unduly interfere with the students' studies. An increasing burden fell on the student engineers as the number of courses offered on television increased, and as additional systems were installed on the campus.

When the University became involved in extensive kinescope recording operations, and completed its plans to provide a daily television broadcast during the summer of 1957, it became necessary to hire a full-time engineer who began work in April 1957. However, he will continue to have student engineering assistants.

The on-the-job training for both student camera operators and engineers has shown its value in subsequent employment opportunities. The demands for individuals trained in several skills on the TV Project at Penn State are already heavy and are increasing as more and more similar projects are being initiated.

Student Classroom Assistants

In an earlier section of this report a detailed account was given of the roles taken by students, either seniors or graduate students, as teaching assistants. Their work ranged from merely taking attendance to the conducting of discussion sections supplementing the lecture demonstrations given over television. Students were selected on the basis of scholarship and interest. Generally they performed satisfactorily and gave considerable assistance to the instructors in the televised courses.

There were a few instances, however, when unfortunate selection and lack of necessary training of student assistants resulted in unsatisfactory classroom behavior. These students set an example of behavior that was undesirable but copied by students in the classroom. However, good TV teaching assistants can play a very important role and their behavior may set the "tone" for the classroom. This was done effectively by many teaching assistants.

It seems reasonable to assume that as time goes on, more varied and extensive use will be made of advanced undergraduate and graduate students as teaching assistants and that they will have increasing responsibility given to them. It is believed that this experience may influence some of these students to become college teachers while at the same time contributing to their general academic advancement.

TV Operational Staff

As was mentioned earlier in this section, an effort was made to find and engage people on-campus who could staff the television operations. Several individuals who had experience in motion picture work were available from the staff of the original Instructional Film Research Program out of

which the Penn State TV Project developed. They rapidly adapted to the requirements of television. Because of the emphasis of the Instructional Film Research Program on effective instruction, they were aware of the major elements that are essential for a good instructional presentation. Other universities may find similar people in the audio-visual, drama, radio, or speech departments.

For 1955 through 1957 the operational TV staff consisted of three full-time people (a full-time engineer has recently been added). Part-time assistance was given by two graduate students who were interested in television production for educational purposes. The Penn State TV Project has generally followed the policy of training its own operational staff rather then employing television professionals.

The initial operational staff has trained some promising senior students in television instruction and its requirements. One of these has become a full-time member of the operational staff.

Whether this procedure is best is not certain because only this method of staffing has been tried. What can be said is that this method has proven to be practical at Penn State. Additional assistance in operations was given by the director and associate director of the TV Project especially at crucial points and critical times.

Coordination between TV Project and Instructors

Teaching by television places new and additional demands on university instructors; new adjustments are required; new possibilities and challenges confront the TV teacher, and he needs assistance not previously required. However, providing him with the needed assistance, calling his attention to new possibilities and helping him adjust to teaching by television are not easy accomplishments.

The TV Project performs three different staff functions. The operational staff handles the day to day television presentations. The research staff works with instructors on the design and execution of experiments, and overall coordinating functions are performed by the director and associate director of the Project.

At Penn State the autonomy and responsibility of the TV instructors are fully respected. Instructors are never "directed." Suggestions may be made about methods and techniques of presenting instruction but they alone decide what will be taught. Suggestions may be made about problems of course management but the instructors alone decide whether or not to accept them. New possibilities may be called to their attention but generally an attempt is made to get the instructors to see for themselves the new possibilities and then to develop them with some assistance.

When the TV staff works within these guide lines, extreme tact and diplomacy is required. It is necessary for members of the staff to define for themselves roles of service and of coordination which are subordinate to the instructors. What can be accomplished depends heavily on the personalities and temperaments of the individuals involved.

Effective instructional presentations over television require a high level of mutual cooperation between instructional and television staffs. Experience has shown that instructors depend heavily on the television staff for assistance, especially when they first begin to teach over television.

Coordination of TV Presentations

For most televised classes a crew of four persons handled the televised presentation for the instructor. An operational member was in charge of the TV system. He was also responsible for coordinating the television system with instruction. He was assisted by two student camera operators. A student engineer was also on duty to turn on receivers, check picture quality and take care of any minor equipment troubles that might develop. The same group worked with the same instructor (s), whenever possible, throughout the entire semester. The coordinator for a particular course would often contact the instructor during the week to discuss future presentations, to exchange suggestions, or to try out new ideas. He always spent a few minutes with the instructor immediately prior to a class in going over materials to be presented.

Each of the three operational staff members accepted responsibility for certain courses and provided the principal day-to-day contact between the TV activity and the professors.

In addition to the above, each of the three staff members had additional duties. One was responsible for the scheduling of camera operators and generally for coordinating operations, another took care of special presentation problems or display devices that might be needed. The third staff member was a skilled artist who handled the production of special visual materials as required. As was stated previously, a full-time TV engineer has been recently added to the staff. He is responsible for the installation and maintenance of all TV equipment and for scheduling, training and supervising all student engineers.

The size of the operational TV staff was kept to a minimum and each member performed a number of different kinds of work. Specialization was greatest with the engineers and student assistants. The regular full-time staff members were generalists, and capable of diversified work, thus they contributed to the economy, flexibility and adaptability of the TV operation. Having staff members available with a wide range of skills and a willingness to work hard for long hours in using these skills without restrictions are very necessary conditions for conducting such an activity as is described in this report.

Coordination of Research

Procedures similar to those just described were followed in coordinating and conducting research projects. Generally a given research project was developed jointly by the research staff of the Penn State TV Project and the professor who taught the course in which the study was made. The research staff was fairly evenly divided between full-time and part-time staff members as well as graduate assistants working for advanced degrees in psychology. The idea for an experiment came either from the professor or the Project research staff, but usually from the latter. The general objectives of

the TV Project were important in selecting and defining specific research tasks. In either case the research was developed jointly and finally approved by the research staff. A member of the research staff was assigned to coordinate each project. He maintained close contact with the instructor, assisted in the construction of tests, helped with the collection of data, actually handled the testing if this was agreed upon as part of the project, and finally supervised the processing of the data. In this way every effort was made to prevent any mistakes, or failures to follow proper procedures, which often ruin experiments that are conducted in the context of a realistic on-going program of instruction.

Where randomization of students to groups was required, the research staff member assigned to the project also did this, if necessary being present when students registered for the course. Overall coordination of the research projects was exercised by the director and associate director of the TV Project, and this was generally achieved in regular weekly meetings with the research staff.

Cost Analysis of Teaching by Television

One of the questions most frequently asked by those who are considering the use of television for teaching is, "What does it cost?" This general question is asked against the background of rather vague information about the high costs of image orthicon equipment and the costs of operating fully equipped professional broadcast studios. The questioners frequently imply that however useful and desirable television may be for a college or university, it is too expensive for an educational institution.

There are other points of view that relate to costs which strongly emphasize the need for dependable cost analyses and sound estimates of expenses. A cost-conscious university president may ask, "How much money can be saved by using television?" A faculty member may believe that costs are far higher for televised teaching than for conventional methods of instruction and that the additional money spent on television would be far better applied to faculty salaries. Other administrators may view television as adding further costs to their present instructional programs and hence they think it must be justified in terms of improved quality of teaching or as a means of providing special and supplementary teaching aids such as magnifying both demonstrations and teaching materials.

Many people are concerned with how instructional television can be financed. At present it would seem that the majority of this interest group has considered television as an auxiliary or exploratory adjunct to the central academic efforts of their institutions, and as such it should be financed by grants, gifts or other "outside funds." Others think of financing television by means of special legislative action on appropriations for this purpose. Up to now most administrators have not conceived of television as a means of providing a regular service for their teaching programs, and so have not budgeted costs in terms of standard budget items such as salaries, wages, equipment and supplies. Hard cold facts are needed on how instructional television may be financed, how it will modify the financial position of an institution and what the economic picture will be under a variety of operating conditions.

Information on these points is not easily secured. Experimental and exploratory projects often do not afford a sound basis for estimating costs because as pilot experiments they are more expensive than regular routine operations and do not make full use of the capabilities of TV systems. Educational institutions may lack the necessary cost accounting procedures for calculating costs and earnings of a limited instructional project. "Hidden costs" or "overhead" items are difficult to estimate. Productivity factors in education have not been clearly defined and measured. The costs of different kinds of TV systems vary greatly and so do the expenses of operating them under the wide range of conditions which exist in different colleges and universities. Therefore, the results of cost analyses of instructional TV should be considered as tentative, and it should be realized that the results will differ from one institution to another depending on the main factors which determine both costs and productivity. Generally, these cost factors are:

(1) the cost of equipment, its installation and depreciation.

(2) the cost of maintenance, parts (especially electronic tubes) and supplies.

(3) the cost of operating personnel, both salaries and wages.

(4) the cost of instructional personnel.

(5) overhead, administrative and miscellaneous costs.

The productivity or earning power of televised instruction, as with all teaching procedures, may be defined as the amount of instruction provided in terms of student-credit-hours.

Cost and productivity factors are relative. Both may vary from institution to institution. They are relative also to other teaching procedures, courses and curricula within the same institution. Hence, it is necessary to calculate costs and productivity on a comparative basis between TV and conventional procedures in the same institution and in the same courses.

During the academic year 1956-1957 it was possible to increase the scope of operating a Dage 320 professional system for four courses to the point where they could be considered as a suitable operation on which both costs and productivity could be assessed. Records were kept from which cost figures for these four courses could be calculated for conventional procedures and for procedures involving the use of closed-circuit television. Furthermore, by using these basic figures, it was possible to project cost and productivity estimates as functions of the principal factors which determine costs and productivity.

Analysis of Operating Costs

Cost of Equipment and Installation (Capital Investment)

The Dage 320 vidicon professional system as installed and operated in the Sparks Building at Penn State was used as

the basic equipment system for the cost analysis. The equipment and installation costs using 1957 prices and labor charges were estimated as follows:

Item	*Cost*
Dage 320 Vidicon Professional Dual Camera Chain (Complete with Controls)	$18,300.00
Dage Film-Slide Chain	8,000.00
Racks and Patch Panels	500.00
2 Video Monitors	500.00
Question-Answer System (Local Construction)	2,260.00
32 Receivers, 24" Westinghouse	4,800.00
30 Receiver Stands	750.00
Lighting Equipment, 2 Originating Rooms	1,100.00
Voltage Regulator	485.00
Test Equipment	2,000.00
Building Modifications, Drapes, etc.	500.00
Audio System	3,500.00
Distribution System	2,000.00
Total	$44,695.00

Estimates of Depreciation and Obsolescence

Electronic television equipment is still being developed; new models are being designed, produced and marketed; circuits and tubes are being improved. Hence, such equipment has a relatively short effective life and a high rate of depreciation and obsolescence. This rate varies with different systems and their components. For the system under consideration, the Dage Vidicon 320 professional system, discussions with the factory representatives plus records kept at Penn State led to the estimate that the system would have an average effective life of from five to eight years. The very conservative period of five years has been used as a basis for calculating depreciation and obsolescence.

A correction is needed for the academic year of ten months during which the system is used for regular course instruction. The system is used for other purposes during the summer months.

Thus, the depreciation and obsolescence cost for the academic year of 1956-1957 is calculated to be $7,543.33.

Maintenance Costs

The costs of labor, parts and supplies yield the total maintenance cost. Each student engineer kept a strict record of his working time classified under categories of capital improvement, maintenance and repair and operating services. Test equipment is included in equipment costs and depreciated at the same rate. Thus, maintenance costs for the academic year 1956-1957 are calculated as follows:

Engineering Labor, Maintenance and Repair	$2,106.65
Parts, tubes, supplies, tools, etc.	1,136.36
Total	$3,243.01

Costs for Operating Personnel

Personnel operating costs include the salaries of regular full-time and part-time operational staff members, the wages of student engineers on operating assignments,[1] wages of student camera operators, and an overhead of 10 percent of the total for administrative and clerical time and office supplies. The total net operating cost for the ten months period is given below:

1. Operational Costs		
a. Salaries of Operational Staff Members		$11,123.75
b. Wages:		
Student Engineers (Standby time)	$2,753.59	
Student Camera Operators	1,033.89	
Sub-Total		3,787.48
2. Maintenance Costs		
Wages for Student Engineers (Maintenance time)	$2,106.65	
Parts, Tubes and Supplies	1,136.36	
Sub-Total		3,243.01
3. Depreciation and Obsolescence		7,543.33
4. Overhead		2,855.28
Total Operating Costs		$28,552.85

Hourly Rate of Operating Cost

In order to calculate the cost of televising instruction for a given course it is necessary to know the operating cost per hour or period of course instruction. During the academic year of 1956-1957 it was estimated that the system being analyzed operated a total of 1,072 hours for televising instruction and other uses. When the total operating cost is divided by the number of hours of operation, it is found that the cost per hour of operation is $26.64.

The costs of electricity, heat and other basic utilities are not included in this operating cost anaylsis. Data were not collected on the consumption of electric power. It is assumed that for most service utilities the cost will not differ greatly between conventional and televised instruction.

Comparative Costs of Teaching Four Courses by Conventional Procedures and by Closed-Circuit Television

The four courses selected for this study were General Psychology, Introduction to Accounting, Introductory Sociology and Air Science. These courses were taught almost entirely over television for both Fall and Spring Semesters of 1956-1957. They represented a fair range of subject matter. Conventionally the courses had been taught in sections of 45 students or fewer. As exemplified by one course, Air Science, the number of students taught over television

1 Costs for the period under study do not include the salary of a full-time engineer who was added to the staff at a subsequent period when the TV operation was expanded to include broadcasting and kinescope recording.

TABLE 93

Cost Analysis for Four Courses Taught During 1956-1957

Item	*Courses*				*Totals*
Conventional Instruction	*Psychology*	*Accounting*	*Sociology*	*Air Science*	*Total*
Instructors	$20,825.00	$7,100.00	$5,666.00	$50,000.00	$83,591.00
Graduate Assistants	1,400.00	1,400.00	4,108.00	.....	6,908.00
Hourly Labor	.....	.....	500.00	.....	500.00
Totals	$22,225.00	$8,500.00	$10,274.00	$50,000.00	$90,999.00
Televised Instruction					
Instructors	$7,985.00	$1,713.00	$2,100.00	$20,000.00	$31,798.00
Graduate Assistants	1,206.00	2,800.00	800.00	.....	4,806.00
Room Proctors	374.50	450.00	2,070.00	.....	2,894.50
Totals	$9,565.50	$4,963.00	$4,970.00	$20,000.00	$39,498.50
Operating Costs ($26.64 per hour)	5,114.88	2,557.44	2,557.44	2,557.44	12,787.20
Totals	$14,680.38	$7,520.44	$7,527.44	$22,557.44	$52,285.70
Differences (in favor of TV)	$7,544.62	$979.56	$2,746.56	$27,442.56	$38,713.30

approached the total student capacity of the present system in terms of the number of classrooms (19) equipped for reception.

Information available from the responsible department heads for these courses and from the Commandant of the Air Force ROTC unit at Penn State was used in calculating the net cost of instruction for each course as conventionally taught in sections of about 45 students and as taught by using closed-circuit television. In both cases the net cost of instruction, including all salaries and wages, was used. The costs of space, utilities and other costs auxiliary to instruction were not included in the comparisons. Table 93 shows the estimated costs of instruction for the conventional procedures used in each semester course and the costs when closed-circuit television was used.

Another approach to cost analysis is in terms of comparative costs for student-credit-units. Table 94 gives this analysis for the four courses under consideration and for the Fall and Spring Semesters of 1956-1957.

Tables 93 and 94 illustrate a number of important facts:

1. That a professional vidicon television system can be so used as to reduce instructional costs significantly when compared with the net costs of teaching the same courses by procedures previously used at Penn State. The total difference gain (saving) for the four courses during the academic year, as calculated, amounted to $38,713.30.

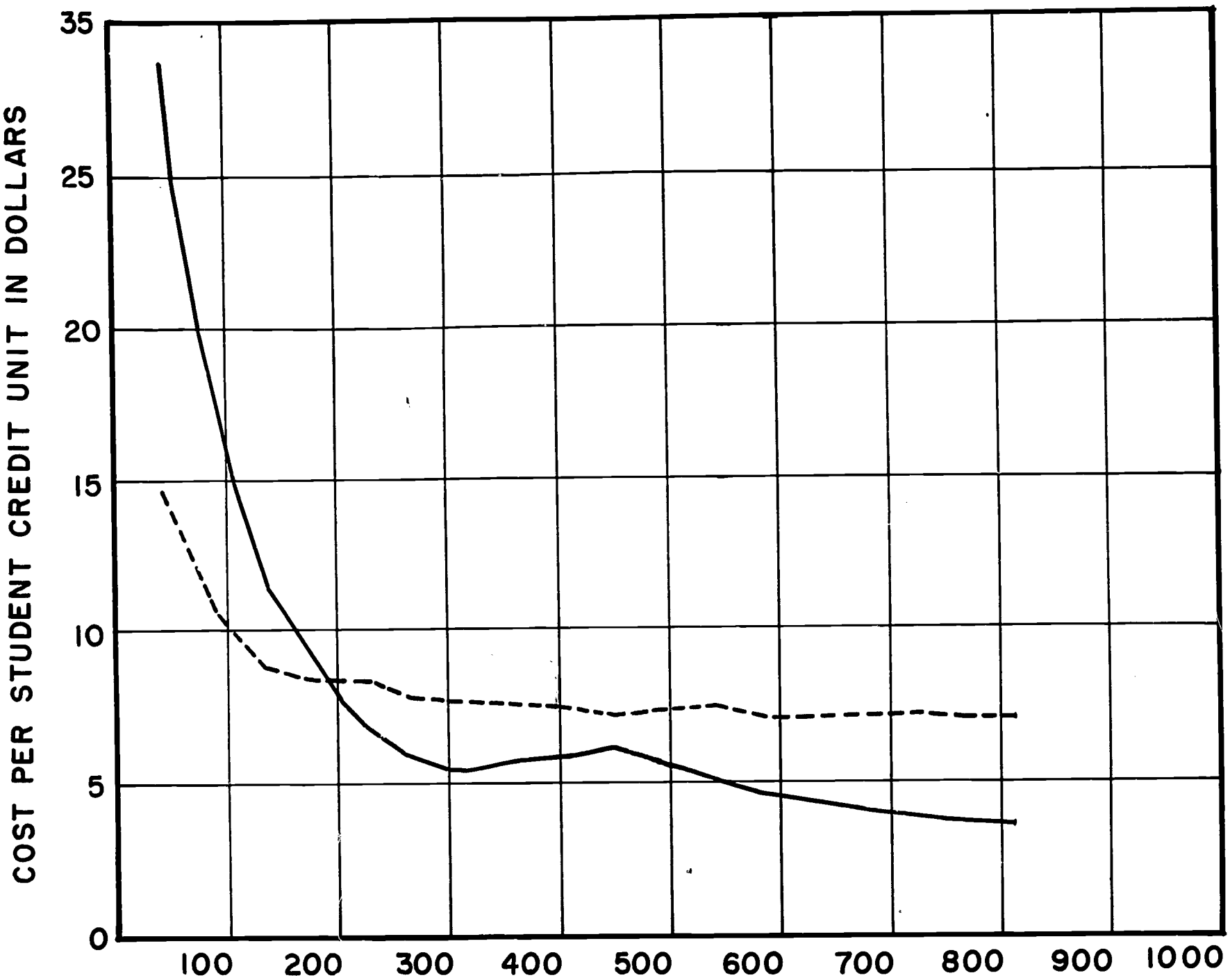
2. The cost per student-credit-unit can be reduced correspondingly. For the courses studied the average reduction was $4.04 and the range of saving was from $.76 in Accounting to $8.47 in Air Science.

3. Costs are very sensitive to the patterns of course management, staffing and especially to the number of students involved in televised instruction.

TABLE 94

Comparisons of Student-Credit-Unit Costs of Conventional and TV Instruction

Course	*Total Students Fall*	*Total Students Spring*	*Total for Academic Year*	*Course Credits*	*Total Student Credit Units*	*Net Cost Conv.*	*Net Cost TV*	*Diff.*
Psychology	575	651	1226	3	3678	$6.04	$3.99	$2.05
Accounting	220	209	429	3	1287	6.60	5.84	.76
Sociology	169	297	466	3	1398	7.35	5.38	1.97
Air Science	810	810	1620	2	3240	15.43	6.96	8.47
Totals	1774	1967	3741		9603			
				Student-Credit-Unit Cost Averages		$9.48	$5.14	$4.04



GRAPH IX. COSTS PER STUDENT CREDIT UNIT OF TELEVISED AND OF CONVENTIONAL INSTRUCTION FOR VARIOUS NUMBERS OF STUDENTS

Costs Related to Number of Students Taught Per Period by Television

There are basic cost factors which amount for most of the total costs and these must be met independently of the number of students taught during a period in a multiple classroom TV section, whether there are 100 or 1,000 students being served. These basic cost factors are those of the equipment, the cost of operating the equipment and the cost of the instructional personnel and materials. There are other and relatively minor costs which relate directly to the increased numbers of students. These are costs of additional TV receivers and cable connections, costs of extending supplementary audio systems, especially speakers, and question-answer systems if these are used. Additional classroom proc-

tors and teaching assistants may be needed, and there will be some increase in engineering service for the additional receivers and extended audio and question-answer systems. Additional help will be needed for preparing, administering and scoring examinations and tests. Generally, however, it will be found that once the basic system and operations are provided, the number of students served can be progressively increased without proportionally increasing the cost of instruction. Conversely, the average cost for each student-credit-unit can be greatly reduced as the number of students in TV sections increases.

Costs cannot be controlled in this manner when typical conventional procedures and fixed student-faculty ratios are used. For example, when large college and university 3-credit courses are taught in classes which average 30 to 45 students per class, and when faculty workload is determined to be 12 credit-hours per week, one additional faculty member will be needed for student-credit-unit increases of between 1,440 and 2,040. Thus, the number of additional faculty members needed will increase in direct relationship to the increase in enrollment of students.

There are, however, other solutions to this problem than that of televising instruction. Faculty workloads may be increased. Student-faculty ratios may be increased. This latter will require marked increases in the average class sizes. In fact, large classes of 200 to 400 students would be an economically competitive alternative arrangement to teaching by television. However, whereas TV systems can easily be expanded by connecting additional classrooms as necessary to serve increased numbers of students, large classes will be limited to the number and sizes of large classrooms, lecture halls and auditoriums available in an institution. The size of TV sections will be limited to the number of classrooms available at a given period in one or more buildings and to the number of students who can schedule a particular course at a given time in the weekly schedule.

As the number and kinds of courses available for presentation over television have increased at Penn State, and when more than one course is available for a weekly time sequence, the problem has arisen of which course to select and schedule on television. Among many other considerations is the one of the number of students registered in the course. Very clearly, other things being equal, the course with the largest number of students should be scheduled over television.

This problem raises the question of how many students are required in a TV section to permit the distribution of the net instructional costs plus the cost of operating the TV system so as to reduce or maintain a level of costs which is not higher than normal.

Graph IX represents a plotting of costs per student-credit-unit in relation to assumed numbers of students taught by both conventional and closed-circuit television procedures. For purposes of this analysis, the net cost of conventional instruction was calculated using all academic ranks (professors, associate professors, assistant professors, instructors and graduate assistants) in a proportion typical at Penn State. Also, it was assumed that the faculty workload would be 12 academic credits or four 3-credit courses or the equivalent. Finally, it was assumed that class size would average 45 students. Generally, these calculations were based on the four courses being subjected to this cost analysis.

In calculating instructor costs for courses being taught by television, the salaries of the actual instructors were used. Since the instructors chosen for television were generally of the higher ranks including associate professors and full professors, the annual salary charge included is higher, on the average, than the salaries for conventional instructors. Here again, information for the amount of annual salary applicable was obtained from the responsible department heads.

This Graph shows that the breakeven point, i.e., the point where the cost per student-credit-unit is the same for conventional and televised instruction, occurs at the level of about 190 students, considering all four courses as the basis for the composite curves. Each course varied somewhat from the average breakeven point but the fluctuations were not great. These curves, as projected, show that the economic advantage of using television begins with classes of about 200 students and increases progressively from this point as the number of students in TV sections increases. It will be noted that the curve for TV instructional costs is shown to increase and then decrease again in the range of 400 to 500 students. This is the result of an assumption that for every 400 to 500 students added to a TV section, the equivalent of one average full-time academic position will be needed. This additional help can be provided in the form of a faculty member, and/or selected undergraduate or graduate students.

It should be observed also that the cost of teaching fewer than 100 students by television is much higher than by conventional procedures. Thus, it may be concluded that unless there are qualitative gains in instruction or other advantages, the use of closed-circuit television for teaching in a context similar to that of Penn State will be found to be feasible for courses of more than 200 students.[1]

The relationships between the number of students in a course and net cost of instruction for both conventional and TV courses are shown in Table 95.

TABLE 95

Estimated Costs per Student-Credit-Unit for Varying Course Enrollments

Presentation	*Estimated Student-Credit-Unit Costs (See Chart IX)*		
	N = 135	*N = 675*	*N = 1216*
Conventional Procedure	$8.86	$7.24	$7.05
Televised Instruction	11.32	4.27	3.00
Differences	−$2.46	+$2.97	+$4.05

Additional Cost Advantages of Teaching by Television

The instructors in Air Science developed a satisfactory method for giving tests and examinations over television

[1] Relatively smaller numbers in a TV course may be justified during the developmental phases of televised instruction or for purposes of an experiment.

simultaneously to about 800 students. The students used IBM answer sheets for their responses to questions and problems. This procedure was estimated to save $800 over the usual examination procedure in costs of paper, stencils and mimeographing services. Furthermore, the security of the examinations was easily controlled since only one copy was needed for televising.

Another cost factor should be noted. It is exceedingly difficult to have instructors agree on a common examination in multiple-section courses taught by a number of different instructors. Generally, each wants to prepare his own examinations to correspond to his particular version of the course. Thus, in such a course it is not unusual to have as many different examinations as there are instructors. Consequently there is an excessive expenditure of test preparation time, clerical services and supplies.

Finally, it should be noted that adding instructors as student enrollment increases makes additional demands for office space, administrative and clerical services. These will certainly add more to the cost of conventional than to expanded televised instruction.

Generalizations and Policy Suggestions Relative to Costs

One of the objectives of the Penn State TV Project was to investigate the question of whether by using closed-circuit television the trends of increasing costs of instruction could be stabilized or reversed. The evidence presented suggests that with good management either can be done. As exemplified by the course in Air Science, it would seem reasonable to expect that for many courses with large student registration, instructional costs can be reduced by 50 percent, and on the basis of evidence presented in Chapter II of this report, it would appear that this reduction of costs can be accomplished without reducing the existing quality of instruction.

In view of these possibilities it would seem to be sound administrative policy to deal with closed-circuit television as another main teaching facility which can be justified and supported by the regular budgets of large colleges and universities. Investments in equipment and operating expenses can be expected to pay good dividends. It is estimated that the use of a professional vidicon system to the extent and in the manner in which it is employed at Penn State can yield a gain for each academic year of about $50,000, or more than the total cost of the system. If the life of the system is conservatively estimated at five years, its total net earning potential could be $250,000.

Caution and wisdom should be exercised in using or reinvesting the gain potentials of closed-circuit television. It is suggested that a policy governing a TV operation should be established which would define a limit for credit-unit-costs and would suggest that all additional gains be reinvested in the particular course where the savings are made. Such funds could be used to employ the best available instructors. Their salaries could be increased in some proportion to their productivity and they could be so scheduled as to provide adequate time for improving their courses as well as time for professional and personal development. Funds from such savings should be made available for the procurement and production of the best possible instructional materials. Furthermore, the TV instructors should have all necessary assistance and services for doing a first class job of teaching and for providing means of compensating for the inherent and well know limitations of tele-education.

In terms of the impending enrollment crisis in higher education, including a possible critical shortage of qualified faculties, television can be used as one feasible means of breaking the economic and quantity barriers. Before the educational productivity barrier can be regarded as breached, great effort and much wisdom must be directed toward penetrating the quality barrier. Both quantity and quality are component parts of educational productivity and effectiveness. Large investments of both funds and brain power need to be made in an attempt to improve significantly the quality of higher education.

Summary

In this section of the report observations and evidence have been presented to support the conclusion that the use of vidicon television systems for instructional purposes is feasible in a university. Several levels of equipment systems have been tested and proven to be dependable in operation and to have adequate performance characteristics. The systems have been installed and successfully operated under typical but less than optimum conditions in existing classroom buildings. The relative advantages and disadvantages of video and radio frequency distribution systems were reviewed. It has been shown to be practical to install, maintain and operate vidicon closed-circuit systems with personnel normally available in a university. Electrical engineering undergraduate students can provide the needed engineering services for closed-circuit operations. This may not be possible for kinescopic recordings and regular broadcast activities. Undergraduate and graduate students can be selected and trained to serve effectively as teaching assistants. An operating staff can be developed to conduct the televising of instruction and to coordinate this activity with instructors and yet leave the instructor with the major responsibility for teaching. Research can be coordinated with the regular and almost full-time televising of courses of instruction. A detailed cost analysis has been given for four courses. Under given conditions conventional instructional costs can be reduced by using television with relatively large classes. The cost of operating a professional vidicon TV system at Penn State was calculated to be about $26.64 per hour in 1956-1957, based on 1,072 hours of operation for the academic year. A breakeven point between conventional instruction (in groups of 45) and televised instruction was estimated to be about 200 students. The potential of economic gain increases with the number of students served in TV sections but the same rate of gain does not accrue with conventional teaching procedures. Several important policy considerations were raised relative to costs, the quantity and quality of instruction and educational productivity.

6—Present Status of the Penn State TV Project

The date of this Report is the Spring of 1958. Almost a year has passed since completion of the last experiments described herein. During this academic year of 1957-1958 the work of the Penn State TV Project, especially the regular non-experimental televising of instruction, has been continued, expanded and accelerated.

Two professional vidicon TV systems are in full operation supplemented by three low-cost TV systems used for special purposes. Approximately 5,000 students are enrolled in 17 sections of 13 different courses that are being taught this semester entirely or in large part by closed-circuit television. In addition, the television facilities are being used in four courses that offer training to students in various aspects of television production.

Regularly each week 5 hours of educational broadcast programs are being produced using the same vidicon equipment as that employed for closed-circuit instruction. Thus, closed-circuit and broadcast instruction are being integrated to serve the University's educational programs.

A course in Introductory Sociology is televised for 564 students on the main campus, and simultaneously the course is being received by 53 students in sociology at the Penn State Altoona Center forty miles distant from University Park. At the same time this unmodified university course is being broadcast over an area having a total population of about one and one-half million people. This development has two objectives: 1. To determine the feasibility of providing for students in the University's Centers by means of television, the same instruction that is available to students on the main campus. 2. To make it possible for the general public to observe a regular, unmodified college course and thereby to increase their understanding of the academic work of the University.

Cost anaylses were reported in the preceding section. The favorable balances were shown to be derived mainly from the costs of unfilled positions and saved faculty time. What have been the kinds of redeployments this year of positions and time?

No faculty members at Penn State have been released because of reduced needs for them resulting from the use of television. The request for Air Science teaching staff to the Department of Defense was reduced by two full positions. In Sociology, time saved by using television was made available to faculty members for research. The same was done in Psychology. Additionally, in Psychology the demands of increased student enrollments in many courses and the need for expanding graduate training were met without adding the usual number of new positions. In Accounting, a field where there is an acute shortage of teachers, the department has taught the required number of students without filling vacant positions. Thus, vacant positions remain unfilled and time of regular faculty members saved by using television is being reinvested.

Moderate-cost kinescopic recording equipment compatible with vidicon camera chains has been successfully developed and used. The core materials of courses in General Psychology and General Chemistry have been kinescopically recorded for the Department of Defense. Studies have begun on the effectiveness and methods of using regular courses of instruction recorded on films.

Research is being conducted on the application of closed-circuit television for improving the effectiveness and efficiency of science instruction in chemistry laboratories. Comparisons in terms of the measurable learning of students are being made between teaching done by regular faculty members over television to large numbers of students and teaching done by graduate students with limited teaching experience using small classes of students taught directly.

Important administrative actions are being taken. The University is accepting an increasing proportion of the costs of the Penn State TV Project. The Educational Policy Committee of the Senate is conducting a study of the TV Project and preparing a report for Senate action. The Committee on Instruction of the Board of Trustees has observed classes being taught by television, reviewed reports and expressed general approval of the activity.

The Administrative Committee on Long Range Development, in drafting its blueprint for the future, assumed that the use of closed-circuit television would be one important means of increasing the student-faculty ratio from 14-1 at present to 22-1 by 1970. A third professional vidicon system will be purchased and installed. These and other actions support the fact that closed-circuit television is being built solidly into the structure and functions of the University as an accepted and continuing part of the University's instructional program.

Two important, crucial and general problems confront the Pennsylvania State University and other similar institutions throughout the nation:

1. How can the University provide opportunities for higher education to increasing numbers of students in expanding fields of knowledge with their need for complex skills, especially when there is an anticipated decrease in the proportion of well qualified faculty members? This is the problem of *quantity*.

2. How can the University best encourage and facilitate the development of the full intellectual potentials of each individual Penn State student? This is the problem of *quality*.

Relative to televised instruction, the question becomes how and to what extent can television be used to contribute to the solution of educational problems of both *quantity* and *quality*?

The results of the research and development work described in this report support the generalization that by using closed-circuit systems to televise instruction to large numbers of students in general college courses, a very significant contribution can be made toward solving the *quantity* problem. The Penn State TV Project provides a realistic model which is demonstrating how and to what extent this can be done.

The quality problem still remains to be solved. It may be possible to demonstrate that televised instruction can be so conducted and supplemented as to instigate superior academic achievements by students when compared with conventional and generally employed methods of direct teaching. Adequate evidence supporting this proposition is not yet available.

In this connection there arises a fundamental issue of American education: To what degree do differences in methods and means of presenting instruction to college students result in positive differences in their academic achievement and intellectual development? In order to answer this question basic and intensive research is needed in the areas of methods of instruction relative to human personality, perception, motivation, learning and retention.

Thus, Report Number Two: *An Investigation of Closed-Circuit Television for Teaching College Courses* ends with many problems unsolved and questions unanswered. Additional and more fundamental research than has been done is needed. This research would use television, but the focus of effort should be on advancing our understanding and gaining control of the essential factors involved in the teaching and learning processes of formal education.

In the meantime, television is available, models exist for its use and it can be employed without serious reservation toward solving the difficult problem of *quantity* in colleges and universities.

(e) Faculty acceptance was identified as a crucial problem in the introduction and use of instructional television in a university. Generally, conventional methods of teaching were preferred by those instructors who were teaching over television for the first time and many negative attitudes were expressed both by TV instructors and other faculty members toward the regular non-experimental use of television in university courses. On the other hand, a few television instructors were very favorable to the procedure.

(f) The preliminary work during 1954-1955 indicated great possibilities for extending to very large numbers of students the influence and teaching powers of good and superior instructors.

Chapter 9 compared the Penn State Project with other similar projects.

Chapter 10 dealt with practical considerations with reference to equipment dependability and maintenance costs.

Chapter 11 described exploratory applications of television beyond the regular televising of courses.

In Chapters 12 and 13 major unsolved problems were outlined and future plans were proposed for attacking them.

It was very clear on the basis of the first year's work, actually one semester of televising three courses, that continuation of the Project was desirable. It was also clear that the limited scope of the research needed to be expanded to learn where, when, for what courses and for whom the use of television might be appropriate, and to provide answers to questions of feasibility and costs. The rigors of experimental designs needed to be increased for many reasons. It was evident that televised instruction requires changes and adaptations in teaching methods. Work in the direction of adapting courses to television seemed to be desirable in order to take advantage of some of the potentialities of the medium for presenting different kinds of learning situations or for serving specifically defined educational functions. Generally the "shake down cruise" of the Spring Semester 1954-1955 did not provide a fully adequate basis for knowing whether or not the televising of instruction and the equipment could endure under the strain of the "long haul" of regular full-time operations.

APPENDIX

Summary of Report Number One

An important part of the perspective of the use of closed-circuit television in colleges and universities should include a statement of the background of our knowledge in 1954: College courses had been presented over broadcast television. Closed-circuit television, using standard commercial equipment for teaching relatively short, intensive military courses had been demonstrated and investigated. Industrial television systems had been employed to present demonstrations to students in parts of courses. Extensive developments had been made in using closed-circuit television in medical and dental training. However, in 1954 many important questions relating to uses of television in universities remained to be answered.

It was not known whether either moderate or low-cost vidicon television equipment could be selected, developed, installed and operated successfully on regular schedules in university courses. It was not known with certainty whether or not television could be used for presenting the lecture-demonstrations in science courses or complete courses of the liberal arts type *over an entire semester* without adversely affecting the academic achievements of students. Finally, it was not known to what extent regularly televised conventional instruction would be accepted by students, teachers and administrative personnel or by the interested friends and supporters of a university. Furthermore, in 1954 there were little or no data for estimating the cost or the practical feasibility of multiple closed-circuit TV installations used for regular course instruction. All of these and other questions needed to be answered.

A brief summary of the findings and tentative generalizations of Report Number One, 1954-1955, is included here to provide a setting for the present report.[1]

Chapter I of Report Number One presented a number of general problems which, now or in the future, will confront colleges and universities, all of which are related to the expanding populations of students seeking higher education. These problems are: (a) serving greatly increased numbers of students while maintaining or improving the quality of college education, (b) securing adequate faculties for meeting the expanding demands being made on educational institutions, (c) providing buildings and facilities appropriate to academic needs, (d) making more efficient use of available superior teachers, as well as the problems resulting from (e) the increased scope and differentiation of curricula, (f) the increased costs of higher education, and (g) the increased requirements for general and graduate education. Several viewpoints were expressed on the problem of *improving* instruction. A relevant miniature theory of instructional communication was proposed in an attempt to put television communication into its proper perspective. Some of the limitations and advantages of closed-circuit television were estimated. The need was emphasized for more and continuing research on problems of the improvement of teaching and the advancement of learning.

Chapter 2 reviewed the purposes, origins and development of the Penn State TV Project. The main characteristics of the Project were described as well as the early approaches to continuing and extending experimentation.

Chapter 3 described the organization of the Project.

Chapter 4 dealt with methods and procedures and gave diagrams which showed arrangements of the physical facilities.

Chapter 5 described in detail the equipment, space and facilities used in the research.

Chapter 6 explained how the systems were operated.

Chapter 7 dealt with tests and measurement problems and procedures.

Chapter 8 gave results relative to the main objectives of the Project. Briefly, the results obtained were the following:

(a) Two professional closed-circuit vidicon systems located in separate buildings and producing two different courses given at the same hours can be installed, maintained, and operated regularly for a full semester.

(b) When conventional instruction in the lecture-demonstration part of general chemistry and in two different lecture courses in psychology was televised to students and compared with the same instruction presented directly or "conventionally" to students by the same instructors, no statistically significant differences were found in the examination scores.

(c) No changes in the relative effectiveness of the two teaching methods were discovered during the course of the semester.

(d) When conventional instruction in the three courses was televised regularly over an entire semester to students it was acceptable to them as judged by the results of paper-pencil attitude tests and the lack of strong overt rejection. However, a minority was opposed to televised instruction. Furthermore, no measurable trends of favorableness or unfavorableness toward televised instruction as expressed by students appeared to develop over the semester's courses although there appeared to be fluctuations in student attitudes.

[1] Project Number One: An Investigation of Closed-Circuit Television for Teaching University Courses. The Pennsylvania State University, July 31, 1955.